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FOREST PRODUCTS INVESTIGATIONS*

BY HOWARD F. WEISS

C. F. Burgess Laboratories, Madison, Wis.

It is the purpose of this paper to review the progress in forest products which has been made in this country from 1900 to date and to indicate along what lines efforts can best be directed during the next twenty-five years.

The first quarter of this century has seen a truly remarkable advance in practically every phase of forest utilization. We are now assurably in a mutation period. Forest exploitation and waste on the one hand are slowly giving way to forest conservation and efficient utilization on the other. No longer does the most standpat timber land owner talk of unlimited forest resources; no longer does he ridicule the growing of forests for profit. He does, however, question the practicability of doing so, and in this he still has ample justification for his belief.

I doubt if in 1900 there was any lumber company, certainly no large one, that seriously attempted to operate its timber holdings on a sustained yield basis. Today there are several companies, scattered in the north, east, south and west that do so; some even plant trees on their logged off lands.

The foresters can therefore take heart in the knowledge that their appeals have taken root and fallen upon willing and sympathetic ears. This does not mean that the foresters are better prophets than lumbermen or paper men. It simply means that economic conditions have so changed that it is now becoming practical to apply some of the principles for which foresters stand. This, as I see it, is the biggest change that has taken place during the first quarter of

*Presented at the Annual Meeting of the Society of American Foresters.

the present century. There is no question but that as time goes on, these economic changes will stimulate more and more the conservative cutting and complete utilization of our forest wealth, thereby hastening the day when the forests will be managed as a perpetual, rather than as a fugitive crop.

To outline all the noteworthy advances made in forest utilization during the past quarter century would be to extend too much the dimensions of this paper. Therefore I will attempt to point out only those lines of progress which I believe have been most significant in bringing about a more complete forest utilization and which are shortening the time until our forests will be operating on a sustained yield basis.

One of the most noteworthy advances in the past twenty-five years was the establishment of the United States Forest Service as an efficient reality. This gave an official seal of approval to the forest problem and formed a nucleus, about which effort could be crystallized. The beneficial effects of this establishment will be appreciated more and more as time goes on. The subsequent creation of the Forest Products Laboratory and its development into the finest laboratory for forest research in the world, is an accomplishment to which all Americans can point with pride. The stimulating effect of this institution upon forest research, has already made its deep impress not only in this country but in the nations throughout the world.

The past twenty-five years have seen some interesting and important developments in the lumber industry,—the largest and most important wood-using industry we have. While there have been no revolutionary changes in methods of converting logs into lumber, there has been much refinement in the technique of doing so. This period has seen the construction and operation of some huge saw mills that cut half a million or more feet of lumber per day. The operation of these large units has enabled a more efficient utilization of the log, both in the matter of sawing and dressing the lumber and utilizing those parts too small for lumber.

There has been a decided tendency of late to cut up stock for industrial purposes at the sawmill, thereby saving in freight, reducing manufacturing costs, and eliminating waste. As time goes on this practice will undoubtedly grow.

In the drying of lumber, splendid progress has been made and much degrade and waste due to checks, stain and warp, have been

eliminated. The time is not far distant when practically all grades of lumber will be kiln dried.

The various lumber producing regions are also standardizing more and more on grades, thus eliminating waste and much confusion. Grading lumber for strength has also been started, but much more can be done along this line. The work of the Forest Products Laboratory in testing the mechanical properties of wood, has given this country more complete information on the mechanical properties of its woods than any other nation on earth. This work has exerted a powerful influence in the more efficient use of wood for construction purposes, as is reflected in industrial specifications in the building codes of cities throughout the country.

In spite of the better manufacturing methods developed, the lumber business is continuing to lose ground. By this I mean the consumption of lumber and lumber products is decreasing in spite of an increasing population. The reasons for this situation I will point out later.

In the pulp and paper industry the most interesting progress has been the enormously increased consumption of pulp and paper products and the thousand and one ways in which these products have entered into our daily lives. Contrary to what has occurred in the lumber business, the production of pulp products has increased rather than decreased and the peak load is yet to be attained. Also contrary to the lumber industry, legislation has stimulated rather than curtailed the growth of the pulp and paper business, as is attested by the health laws on the statute books of several of our states. The production of pulp and paper products in the United States increased from 2,200,000 tons in 1899 to 8,000,000 tons in 1922, while the production of lumber decreased from 35 billion feet in 1899 to 27 billion feet in 1921. The maximum production was reached in 1909 when 44 billion feet were produced.

While there has been no new pulp process fully developed during this period, nevertheless there has been much distinct progress in perfecting the processes already established.

Hundreds of new products from pulp have been commercially developed. Among them may be mentioned the manufacture of artificial silk and lacquers, the development of heat insulators called Insulite and Balsam-Wool, the development of sanitary paper products, cellu-cotton, towels, drinking cups, the manufacture of fibre rugs,

furniture, packing boxes, etc., all of which give promise of still greater consumption.

There are other developments which have not yet reached the commercial stage that give marked promise of still further utilizing forest material not now usable. I refer particularly to the so-called semi-cooks for producing high yields of fibre from all sorts of wood and wood wastes which when commercialized will unquestionably result in further forest economies.

A gratifying phase of the pulp and paper development has been the way in which these processes have combined with the lumber industry and are using up both woods and mill waste. Especially noteworthy in this direction is the progress made by the Great Southern Lumber Company at Bogalusa, Louisiana, and the Weyerhaeuser Companies at Cloquet, Minnesota. I believe the time is not far distant when the combination in this country of the two great basic industries, viz. lumber and pulp making, will be as efficiently conducted in the utilization of our forest wealth, as they are now conducted in Sweden.

The naval stores industry has made splendid progress since 1900 through the efforts initiated by Dr. Herty. The old time method of boxing trees has passed into the discard, and there has resulted an enormous saving in southern pine and greatly increased effectiveness in naval stores operations. The investigations of the Forest Products Laboratory, in cooperation with various lumber companies, have resulted in further advancing the method of chipping trees that have not only conserved the timber, but have improved the quantity and quality of the turpentine and rosin obtained.

The researches of Yaryan have opened up a new industry which in spite of its troublesome career to date, will put to practical use enormous quantities of woods waste for the manufacture of turpentine, rosin, pine and other oils. These two big developments, namely the more efficient method of chipping standing timber, and the so-called "extraction" or Yaryan process, will help tremendously in keeping the United States the world's greatest producer of naval stores products, and comprise the most outstanding developments of the naval stores industry in the past twenty-five years.

Many other attempts to utilize resinous woods for the production of naval stores have also been made, but aside from those mentioned and the work of Mason in recovering turpentine and rosin from kiln dried lumber, the progress in the past twenty-five years

has not been great. This is due in part to the lack of standards for the finished products and in part to the lack of market for these products.

The destructive distillation of hardwoods took quite an impetus during the war and improvements were made in the technique of the process which greatly increased the workings of this industry. Of these improvements the better control of temperatures is probably the most significant.

Perhaps the most interesting new development in the destructive distillation of hardwoods is the Stafford process first commercialized at Kingsport, Tennessee. In this process practically all kinds of hardwood wastes in any form whatever can be used for the manufacture of destructive distillation products and by an extremely simple method. The use of catalysers, while not yet on a commercial footing, gives promise of still further improving the destructive distillation industry.

The hardwood distillation industry, however, is now fighting with its back to the wall. It exists largely because of the methyl alcohol produced. Acetone is now being made by the fermentation of corn starch, and acetic acid from acetylene. Processes are now being developed for the manufacture of formaldehyde and methyl alcohol from raw materials other than wood.

The wood preservation industry has developed from a mere handful of plants in 1900 to about 130 in 1924. The total quantity of wood now treated in the United States amounts annually to 225,000,000 cubic feet. An interesting outgrowth of this development is the fact that in spite of increased railroad milage, the consumption of cross ties has been gradually decreasing. For example 154,000,000 ties were used in the United States in 1907 and in 1923 the consumption was 136,000,000. The Santa Fe Railroad used an average of 245 ties per mile of track from 1900 to 1910, but from 1910 to 1920 the consumption dropped to 188 ties per mile. Chemical treatment did this. Encouraging progress has been made in the technique of preserving wood and although the chemicals in widest use have been known a long time, the methods of injecting them into wood have recently been greatly improved. Some comparatively new chemicals like sodium fluoride are coming to the front which will still further advance the progress of this art. Most of the progress to date has been made in the protection of timbers in contact with the ground. Comparatively little has been accomplished in preserving wood that goes into build-

ing construction and this field offers an opportunity for wide application.

For the crating of goods we use roughly 4½ billion feet each year. The problem of proper crating has been attacked by the Government and various private organizations. The result has been that merchandise is now being crated much better and with an enormous saving, due not only to the decreased cost of the crate, but also to much less damage to the goods shipped. This condition has been brought about by proper engineering design.

The outstanding feature of the box industry has been the tremendous growth of fibre containers. In 1899 only 366,000 tons of pulp were used in the box industry but by 1920 the consumption had risen to 2,313,000 tons. The use of such packages has saved enormous quantities of wood because these packages are made largely from reworked paper. In my opinion this development, especially the corrugated box, constitutes one of the greatest conservation movements of this interesting period.

In many other ways attempts have been made to use wood more efficiently. While some of these attempts have failed, nevertheless they point as beacons to future effort. For example, the manufacture of ethyl alcohol from wood has been clearly demonstrated to be operative, but the economic conditions are such that this process has been held back.

We can not point with pride to the development of tanning materials from wood. Aside from the fine progress made by the Chestnut Extract manufacturers the rest of the story is sad. We are wasting annually millions of pounds of good raw tanning material, while continuing to draw heavily on foreign countries for our supplies.

So much for a brief sketch of the progress and tendencies in forest products during the past twenty-five years. What does the future hold forth? It is difficult, if not impossible, to predict the future of wood utilization in the United States. It appears certain that as our population increases, our forests will be crowded more and more out of existence. The extent to which this will go, will depend upon the importance of forest products in our future life. If these products are not vital to our existence and can not compete with products made from other resources, then our forests will become very small in extent and the products therefrom will be of minor consequence. It has already been clearly demonstrated that forest products can not compete with food products on agricultural land. All

foresters will agree with this. It is likewise true that other manufactured products are gradually crowding forest products, especially lumber, from the world's commerce. For example, in the construction of modern ships, modern buildings, modern passenger cars, etc., wood is playing a decreasing role. In fact it is difficult outside of the field of pulp and paper, to mention any commodity made from the forest where a similar product made from some other basic raw material is not even now in successful competition with it. It should be remembered furthermore that all this is happening at an age when wood is still, with minor exceptions, too cheap to pay to grow it. As wood rises in price this substitution of other materials will take place at a still greater rate. This has occurred in every civilized nation on earth and is occurring in ours, as our decreased per capita consumption of forest products shows.

It is illogical to lament the rise in the price of forest products and at the same time bemoan the fact that forests are not being grown. Forests will not be grown in this country or any other, until it pays to grow them. The American bison never would have been crowded into our zoological parks if it could have competed with grain or cattle.

As I see it, therefore, the problem of perpetuating our forests is essentially one of competition. If the products of our forests can successfully compete with the products from other resources then our forests will remain an important basic resource. Otherwise they will continue to be exploited and not developed. In the older countries of Europe, the forests have survived in spite of a dense population and struggle for agricultural land, but the Europeans get much more out of their forests than we do, because they have a demand which we lack for forest products. In time we will probably catch up with them and be toting fagots also. When that time arrives, I doubt if there will be any more idle acres in this country than there are in Europe. If this analysis is correct, then we Americans of 1924, are somewhere between the stage of exploiting virgin forest resources and gathering fagots. If Paul Bunyon could see some of the present day lumber operations in my state of Wisconsin, he could say that we had already arrived at the fagot picking stage.

While we are joy riding from the forest exploitation to the fagot picking stage, we are casting aside yearly thousands of tons of forest material and creating thousands of acres of forest desert. It is this situation that bothers some of us. The remedies for it vary all the way from Government control of forests and forest operations, to let-

ting the joy ride continue. The remedy which appeals most to me is one in which both the Government and the individual would take a hand —the Government to cooperate by levying reasonable taxes and aiding in forest protection, and the individual by efficiently growing, managing and utilizing his crop of trees.

In prescribing, therefore, what the foresters can best do in the next quarter century to help put our forest areas into the best productive condition, I would advocate the backing of a program of enlightened taxation and forest protection. This program is fundamental and without first working it out in a practical way, I see little use of tackling other details. If our tax laws on forest lands and crops were equitable, and if reasonable protection to young growth and standing timber were assured, there would be such an awakened interest in forest perpetuation and utilization on the part of private owners as I am sure would elate the hardest shelled forester. I do not mean by this that the problem would be solved, but I do believe that the greatest single step forward would have been taken. It would prove a wonderful stimulus to owners of forest land to work out methods to utilize their lands and forests to the fullest extent. It would help tremendously in changing their viewpoint from one of cutting out and getting out, to one of cutting right and staying tight.

As to details of future forest products investigations that will help to conserve what we now have and give it greatest value, thought is directed along the following lines:

1. Continuation of the movement to standardize sizes and grades of lumber.
2. A better understanding and use of the grading of timbers for strength.
3. The establishment of cut-up plants at saw mills and other by-product plants to utilize material now discarded.
4. Application of improved kiln drying practice and improved storage of lumber in the yard.
5. Improved methods of protecting wood from decay and an extended use of decay-proofed wood.
6. Continuation of the work in more efficient crating and packing, especially with fiber containers.
7. Greater consolidation of saw mill and pulp mill operations.
8. Continuation of improvements in methods of pulping wood to increase yields, extend the range of usable species and to utilize waste pulping liquors.

9. Stimulate research and development of processes for utilizing mill and forest wastes such as the production of tanning extracts, distillation products, etc.

10. Continuation of naval stores researches to increase yields and reduce damage to living trees.

Activities along all of the above lines are underway, both by the Government and by individuals. Already the efforts put forth have aided tremendously in the better use of our forests and they will undoubtedly continue to do so in the future.

By getting more out of the forest than simply lumber, waste is reduced, and the forest is made more valuable. This increased utilization also makes it possible to keep down the costs of producing lumber, at the same time increasing the value of stumpage. There can be no just doubt but that extensive and efficient utilization aids greatly in growing, protecting and cutting the forest. In fact, such developments are as responsible for the present management of forests as a permanent resource by some timberland owners, as is the gradual rise in the price of lumber, due to the decreasing supply of standing timber.

"FOREST PRODUCTS INVESTIGATIONS"

By Howard F. Weiss

Comments by C. P. Winslow

I have read with great interest Mr. Weiss' presentation of the progress and tendencies in the field of forest products utilization. The importance of this field to the entire forestry movement is so obvious and is becoming so generally and publically recognized that it requires no further comment here. I shall, accordingly, endeavor only to briefly supplement Mr. Weiss' paper with some suggestions as to the nature of the fundamental research which is so necessary to the advancement of better, closer and more efficient utilization of our diminishing forest supply.

Forest products research has thus far been an almost virgin field; and hence, prompt and substantial improvements in utilization processes have been possible largely by the use of empirical methods. These methods have been selected and guided by the best available hypotheses and information on the fundamental character of wood, but they have been, nevertheless, largely empirical. Considering the limitations of available funds, the predominant use of such methods up to the present time has probably been wise. It has become increasingly apparent, however, that they are approaching their limit of utility, and that all lines of improvement are becoming blocked in whole or in part by a lack of fundamental knowledge of the chemistry, structure, physical properties, and pathology of wood, and the relation of these to its uses. Good utilization is also dependent upon fundamental knowledge in timber mechanics, but research in this field has kept more nearly abreast of the attempts to apply it. The relation of mechanical properties to the chemistry, structure, and pathology of wood remains, however, comparatively unexplored.

The field of wood chemistry is one particularly in need of fundamental research, along a number of quite clearly defined lines. It is important that we know more about the various extractives in wood, especially those poorly characterized constituents of the sapwood usually described as "starch, sugar, gums, albumen, etc." There is much to be done still on the cellulose and other carbohydrates and their relationship to each other, and on the composition of the lignin. It has so far been impossible to separate lignin from cellulose except by methods

which evidently have considerable effect on the composition of the lignin, and therefore no one has had a pure lignin to start with in his research.

Such purely scientific studies as these would give information on the detailed mechanism of the chemical pulping processes, wood distillation, the production of sugar and alcohol from wood, and wood decay, and would serve as a foundation for special work on these subjects from the point of view of the process rather than the material.

A distinct field for investigation has to do with the distribution of the cellulose and lignin in the cell structure. The use of stain tests in identifying the various constituents under the microscope is unreliable, and should be supplemented by following the various chemical decompositions of wood under the microscope.

The field of colloidal chemistry is yet another one requiring exploration. There is no doubt that wood is a colloidal material and it has even been claimed that the formation of wood in the tree is nothing but the colloidal adsorption of various sap constituents by cellulose. Cellulose, and especially the cellulose esters and solutions used in making artificial silk and cellulose lacquers, have been studied as colloidal substances, but almost no work on wood has been done from this standpoint. There are several promising openings for research in this field. It has been suggested, for instance, that many of the chemical decompositions of wood might take place differently in speed, distance, or composition of products if the condition of the surface under treatment (a colloidal condition) could be properly modified previous to the treatment.

Closely allied with the colloid chemistry of wood is the consideration of wood as a product of a life process rather than the usual conception of it as a raw material for further chemical treatment. On this subject, the bio-chemistry of wood, we have practically no information. How it is formed, the relation between growth conditions and chemical composition, the physiological meaning of the extractives—these are important fundamental problems that lie all in the future.

Of comparable importance to research in the problems of wood chemistry is the need for fundamental knowledge on the structure and physical properties. Only a few of the relations between the structure of wood and its properties have been worked out, and these range from very empirical in nature to more or less fundamental. The influence of variations in the cellular structure on strength, if known, would be helpful in estimating the strength more accurately than now is possible, and

in regulating forest management to avoid the production of weak timbers for structural purposes. How shrinkage takes place in wood and why there is a great variation in the shrinkage of different species, and even of the same species, has never been satisfactorily explained. There must be some structural differences which account for a range of shrinkage in volume from 7 to 21 per cent for our more important woods. Until the mechanism of shrinkage is better understood, attempts to solve some of the many problems arising from shrinkage, such as checking, warping, case-hardening and honeycombing remain more or less handicapped.

In the field of naval stores, we have found an index to the gum-producing power of a tree, but we as yet know nothing of how gum is produced, or what physiological conditions promote or reduce production. Basic knowledge of the process of formation, storage, and diffusion of oleoresin by pines is essential.

The diffusion of moisture through cells in seasoning, the penetration of preservatives and coloring liquids into fabricated wood or into living trees depends to a large extent on the structure of the wood, not perhaps so much on the size of pores and other semi-microscopic features as on the finer details of the cell structure. This subject is closely associated with the problem of sap ascent, and distribution of different solutions in living trees.

Fundamental research on nature of cell walls, how the walls are built up, how the different chemical compounds of which wood is composed are distributed in the cell wall, how porous tissue which often predominates compares in these respects with fibrous tissue which may or may not predominate in hardwoods, should be carried on independently of any possible practical application because it bears on nearly all problems pertaining to efficient wood utilization.

In addition to research in the structure of wood, there is a growing need for research in the physics of the wood substance itself. The phenomena of hygroscopicity, shrinking and swelling, and transfusion are to be accounted for only in part by structural differences, a remaining part arising from differences in the physical character of the structural material. Likewise, the thermal and electrical conductivity of this material, and all its other physical characteristics, should be the subject of research, which with the chemical and structural research already described, will round out a reliable basis for all secondary research in forest products.

Another field of distinct importance has to do with wood pathology. Prevention or reduction of the deterioration in lumber and other forest products which results from the action of wood-staining and wood-rotting fungi can be accomplished only through accurate knowledge of the organisms which attack wood, of what they are, how they grow, and of the conditions which are favorable or unfavorable to their growth. Our knowledge of the organisms themselves is by no means meager. About their actual growth processes and their reactions to environment, however, we know comparatively little. Some of the facts available are suggested in the following examples:

1. The moisture content of wood in general governs the rapidity of fungous action. Wood which is thoroughly wet will not rot, nor will wood which is dried until the moisture content is reduced below the point unfavorable to growth of the organisms. The moisture and temperature optima for different wood-destroying fungi are not definitely known. Certain fungi appear to develop more rapidly in the light than they do in the dark. Some are easily killed by heat, while others are resistant. Certain building-rot fungi remain alive in the dormant condition in dry timbers for years.

2. Radical differences have been found to exist in the relative resistance of fungi to toxic substances. The nature of the resistance and the nature of the toxic action are not known. Laboratory methods for testing the relative toxicity of certain chemicals have been worked out, but such tests do not explain the process of killing.

3. Apparently certain fungi attack the lignin, while others attack the cellulose. In some cases the fungus destroys the cell wall by boring through or corroding it, and in other cases the fungus produces some substance which seems to dissolve the cementing substances in or between the cell walls. Knowledge of the enzymes produced and their action on wood is very imperfect.

4. The mechanical properties of wood are affected much more quickly by some fungi than by others. The microscopic evidence of decay is not paralleled by the effect on strength, at least in the earlier stages of decay. At present there is no mechanical means for determining the degree of decay in any given piece of wood.

All lines of forest products research present problems which can not be solved without a more thorough knowledge of wood pathology. The foregoing sketch showing the character of present knowledge indicates the necessity for research to determine:

1. The moisture, temperature, light and other environmental relations of fungi which stain or rot lumber and other forest products.
2. The physiological reactions of wood-staining and wood-rotting fungi to toxic substances.
3. The process of decay in wood.
4. The effect of fungous action on the mechanical properties of wood.

The foregoing merely touch upon what seem to me the most important lines which fundamental research should follow. The application of the results of such fundamental explorations for improved utilization will obviously entail and require much research of a more technological and applied nature.

"FOREST PRODUCTS INVESTIGATIONS"

By H. F. Weiss

Comments by E. Fritz

Mr. Weiss' paper presents a truly remarkable list of achievements in forest products investigations and the Society of American Foresters may be justly proud that in their attainment so many of its members have taken leading or prominent parts. The successes of the investigators, notably those at the Forest Products Laboratory, are of fundamental and far reaching importance.

Forestry may be divided into two broad divisions—forest production and forest utilization, the latter including forest products investigations. As much as I honor our early foresters I consider it unfortunate that they attemped to establish forestry through preaching forest production. Forestry, I believe, would be further along now if the first foresters had given more attention to studies seeking more economical and closer utilization. Forestry is still a long way from being established and even in the regions where it has made greatest progress there are too many prominent lumbermen who smile at the thought of spending good money to grow trees. Forest production still strikes many timber land owners as fanciful and visionary, but forest utilization appeals strongly to their intensely practical minds. Of all branches of the Forest Service, I believe the Forest Products Laboratory has made it the staunchest friends. We need the willing cooperation of timber and cut-over land owners, and any acts that are forced upon them will not bring the best results. There should be little difficulty to win them all over to forestry if you can show that it pays to grow forests. You have not been able to prove this through talking reforestation only, except in a few cases, but once you have made it possible to use more of the forest than lumber, the proof should be easy. We are told that the annual consumption of lumber is decreasing and that second growth forests produce principally common grades of lumber. Small wonder then that so few are encouraged to go ahead and grow a second crop, even aside from the burden of taxation and hazard of fire. Right here your forest products engineer finds his field and can step in and save the day for forestry. His researches on the structure and properties of wood lead to discoveries that open new fields of usefulness for wood, especially those parts of trees that are not mer-

chantable as lumber. Wood, as such, has many serious deficiencies but I am confident the forest products investigator will eventually overcome most, if not all of them, and thus hold or perhaps widen the usefulness of this cheap and plentiful material. Remember also that the forest can furnish a bountiful supply of cellulose and lignin very cheaply which the wood chemist is rapidly making available for a great variety of commodities. If lumber is the main concern of the forester he must absolutely develop a profitable use for those parts of forests not suitable for lumber or the lumber produced will be too expensive. Every time we make more of the forest crop useful, we make forestry more feasible. It must be evident, therefore, that the forest products investigator or utilization expert has as much and as important a place in forestry as the silviculturist. His work must be continued, his field enlarged and he must not be divorced from pure forestry.

Let's not worry about decreasing lumber consumption. Substitute materials have made big inroads and as the country settles up we really need less lumber for new construction. Mr. Weiss believes that as wood rises in price the substitute materials will displace it at an increasingly rapid rate. This is true, but I don't fear it will be dangerous. If substitute materials serve the purposes better, it is wise to use them. But remember that they, too, must be made of raw materials, many of which are not of the replaceable kind and which are subject to increasing costs, particularly labor costs, just as is lumber. Furthermore, a vast quantity of second growth lumber will be thrown upon the market in from 50 to 100 years as a competitor. Its price will be reasonable because the forest products investigator by that time will have opened a big by-product field relieving the lumber product of carrying the entire load of cost of production. Lumber in its turn, will thus check rising prices of competitive materials. Crops of wood, we all know, are replaceable and we can always raise more than we will need because I see no possible development in agriculture that will so encroach on our forest land as to endanger the acreage needed. The tendency today is to use less land more intensively. We will have to use forest land just as intensively as agricultural land.

Mr. Weiss has listed a number of items that deserve close attention in future products investigations. I will comment on only a few although all of them deserve some time; I wish also to add a few more.

The standardization of grades and sizes, the preservative treatment of wood, the grading of timbers for strength and the seasoning of lumber are graduating from the experimental stage and already a

vast amount of very useful information has been gathered. I hope, however, there will soon be developed a cheaper and easier method of preserving wood to make treatment more feasible for the small user. The investigations should be continued, of course, but more money and effort should be applied now to disseminating the knowledge gained. There is need for extension facilities comparable to those of some of our agricultural colleges.

I agree with Mr. Weiss that we can not point with pride to the development of tanning materials from wood. It is more than a sad story. There seems to be a growing scarcity of traditional tanning materials, while the chemistry of tannins and the tanning process seem yet to be little understood. Some of our woods and mill wastes should certainly have some usefulness in this field. Take redwood for example.

The wastes incident to redwood logging and milling are enormous and redwood contains a fair amount of tannic acid. A number of laboratory analyses of the wood have been made but it is very difficult at present to get a tanner to try some of the redwood extract out on hides. Think what it means to the redwood country if we should find that its wastes can be used by the tanner. The possibilities warrant a thoroughgoing investigation.

I am pleased at the suggestion that there are great possibilities in the establishment of cut-up plants at the saw mills. I am not at all satisfied that lumbering should be entirely an independent industry and I anticipate that in the future the saw mill will be to a large extent subsidiary to enterprises that refine wood to a finished product. Mr. Weiss has mentioned the combination of pulp mills and saw mills, I would add combinations similar to those of the Ford Motor Co., The International Harvester Co., the Singer Sewing Machine Co., and others. These companies operate logging camps and saw mills not to produce lumber to be sold as such, but boards and small dimension stuff to be worked into their own finished product. It is gratifying to see the large factories rising up alongside our Western saw mills and producing a wide variety of wood products. When the wood is made into a completely finished product, or at least partially so, right at the saw mill it will be possible to divide up logs to much greater advantage, with the added possibility of utilizing material now left in the woods or burned at the mill.

We have overlooked a big portion of the problem of getting the most out of the forest if we devote our efforts principally to the utilization of the wood after it is cut. We must investigate also the manner

and economy of its production. I refer to the logging and milling processes; they have received too little systematic and organized attention. The method of logging is so closely tied up with the type of forest growth which follows that it should engage the attention of foresters nearly as strongly as fire protection. Logging is properly a field for the forest products investigator and so is milling. I see no reason why investigations in both should not be carried on on a large scale by such an organization as the laboratory at Madison, or why at least they can not be centralized under one head for the entire country.

One of the details of milling deserving attention is saw steel. With the metallurgy of steel alloys so far advanced it seems we ought to have a steel that will permit of thinner teeth, or teeth of different design, especially on circular mills. Forest products engineers had to take up the study of glues to solve ply-wood problems; why not also saw teeth and saw steels to solve the saw kerf waste problems. There are many other fascinating details that need attention. Logging, milling and refining investigations appeal to me very strongly as offering splendid fields for development and as additional means of winning friends for forestry.

In closing let me again say that the future of forestry will depend very largely on how economically and intensively every part of the forest can be utilized. For ways and means you will have to depend upon the researches of the forest products investigator.

OBJECTIVES IN STATE FORESTRY*

By Alfred Gaskill

Former State Forester of New Jersey

If this paper were addressed to a general audience it would be well to tell, in outline at least, the story of what has been done in state forestry during the lifetime of the Society, and how, from a group of only five states with little more than nominal official organizations, the company has grown to 28, at least half of which have well established forestry departments supported by substantial, if inadequate, appropriations. But there is little profit in reciting this to you who know it all so well—those whose heads are whitening in the good work, those who will accomplish what we elders have only dreamed. I abandon therefore the recital of accomplishments and aims, and, looking forward as well as backward, try to discover whether the roads we are building, or planning to build, are wisely laid out and carefully graded, or whether the spotters and swampers have been misguided. Surely you do not reject the road simile, but agree that established forestry is not itself our aim; it is a means towards a higher civilization and a better living. And I shall speak plainly of some things that now demand thoughtful consideration.

Looking at our task in its broader bearings, one finds a disposition to differentiate between state forestry and national forestry and to emphasize the latter in ways that challenge the basic principle of our government and raise many questions of fact and expediency. It is fortunate that in the beginning the movement *was* centralized—strengthened by appearing as an inherent interest of the whole people, and in having the public lands to start with. But its essential state quality was soon demonstrated in the organization of state forestry associations, and then state forestry departments. These provided a desirable diversity in program, in control, in general outlook, and set going undertakings that never would have been heard of if all had worked on similar lines. No greater misfortune could have befallen in these formative years than uniformity in state programs, or such centralized control as the National Forest Service at one time was inclined to uphold. I do not consider the rightness or the wrongness of the policy of any state or section; I applaud the freedom with which the right way has been

*Presented at the Annual Meeting of the Society of American Foresters.

sought. Friction and controversy have not been absent, and are likely to reappear from time to time, yet in those again is opportunity for growth. So far as federal activity is concerned, let us agree that the maintenance of National Forests on the public lands is highly advisable—for some years at any rate. We can also agree to—indeed heartily welcome, the extension of federal authority in some directions; money support and much guidance are needed, in return for which the national gain is easily demonstrable. Yet I am clear that it is wise to regard the tendency to turn to Washington as one to be restrained rather than stimulated.

Perhaps I may say here something that in years past has been mostly kept to myself; it is that the dangers inherent in the policy of federal land purchase in the Eastern states constitute a strong argument against that policy. Many of you doubtless can tell how much effort, needed for the development of a state organization, has gone towards the establishment of National Forests.

To stick to my text, I am satisfied that as the years pass, we must expect—indeed work for, more state and less (relatively) federal activity. This in no way condemns or interferes with any present National Forestry Policy—so called. The Clarke-McNary bill is a measure suited to the time and to local conditions in general; there is much work to be done to get the appropriations to make it effective, and most of that work—an increasing part of it, if my experience counts for anything—must be undertaken by and for state interests. Beyond this, and such measures as may supplement it, I see no alternative but complete federal ownership; may the day when that shall appear be far distant.

Within the field of state forestry is found what often is called municipal forestry. It's fine to realize that various towns and cities are using the idea to create woodland parks and to stimulate interest in trees, but, frankly, I shudder at the arguments of some of my good friends in support of such public undertakings. If a town have a tract of woodland, or a water reserve, or even a piece of wild land, by all means let forestry be practiced upon it; worth while returns, direct or indirect, can be counted upon. The danger, to forestry and to the forester-advocate, lies in proposing such undertakings as money profitable investments. How can they pan out when every forester who tackles debit and credit finds himself squirming in the grip of compound interest, or taking refuge in the low interest rates upon which public credit is based. The European examples commonly cited are only misleading because

the all important present valuation and net income rate are apt to be overlooked. Put the thing this way: A town with ordinary needs and resources is offered by a wealthy friend a going forest worth $100,000, *or* that much cash. The cash will yield $4,500 a year sure; will the forest bring as much to the credit side of the budget?

Concerning the fundamental basis of our undertaking—the declared need of an increasing, or even a sustained, provision of timber, I confess to a growing scepticism. Most of Europe is doing fairly well on a much smaller consumption than ours; it builds satisfactorily, usually preferably, of other materials than wood, and even in southern Italy has enough firewood to deliver it beside the chilly foreigner's fireplace at as low a price as most of us pay here. That, of course, is due chiefly, though not entirely, to low labor cost. For ourselves we admit being wasteful in the extreme. Upon what ground is that justified? Surely not by any plea of necessity. Looking at the situation fairly and disinterestedly, we have used wood freely because it has been handy and cheap, not because it always was best for the purpose. Where is the *assurance* that under such competition as anyone here can foresee the use of timber for many, or indeed most, purposes will continue? I can find no escape from the conclusion that we are nearing the time when, with or without forestry, wood will have to stand comparison with other structural materials and win or lose on its merit. More than this, the world in its every aspect is changing so rapidly and so profoundly that one is bound to consider how far it is wise, or indeed honest, to ask the public to support a program based upon the assumptions that this country, or any part of it, will always need as much lumber as it has had, or that wood will continue to be used as it has been. Buildings of stone, brick, concrete and steel; vehicles, furniture, sash and doors, of metal, all point to changes based upon durability, the fire hazard and other factors quite as much as upon the increasing scarcity and higher cost of lumber.

Considering these things is it not time to abandon the contention that lumber prices have risen because we have not practised forestry? It's true in a measure, of course, but as a basic argument it doesn't square with a growing population, longer hauls, higher wages, increased taxes, interest charges, fire protection and so on. And what has Oregon to say about Michigan's lost opportunity, and Michigan herself about Pennsylvania's belated desire to satisfy the timber needs of the populous East? Manifestly it is nonsense to assert that forestry—all the forestry that can be devised, much less all that can be supported, will *reduce* the

present cost of wood products. The best that it *can* do is to check the advance and bring us more gradually to a production-cost basis. The one great hope and promise that we have is that by maintaining forests in every state and working them systematically, mainly for nearby markets, the burden of freight charges, apparently not yet at its peak, will be lessened. Here is where state forestry comes in.

Against this outlook for a decreasing use of sawed lumber one naturally expects a much greater demand for pulp. How far that may go need not be entered upon for it is obvious that cellulose can be derived from other materials than wood—it is simply a question of cost. At the moment it looks as though the forests would continue to be the chief source of supply, and entirely adequate, whether we take the world over or look at the question nationally. It is safe to assume that no state would choose to dominate in this industry. We need not be troubled greatly over the exhaustion of the forests tributary to some mills; it is regrettable, it may have been avoidable, it is an unquestioned loss, yet such losses, unfortunately, attach to some members of every developing industry. How many iron mills have been scrapped in this country, for instance, each a local loss, but a public gain? All in all, can we not be confident that the pulp and paper mills set up in wrong places will give way to others located where the needed supply of wood and water is assured, where many efficiencies will offset any disadvantage of distance, and where new, permanent communities may arise. It is my conviction that something of this kind will be realized; it is also my conviction that an increasing proportion of our wood output will go through the pulp mill rather than through the saw mill. Why not, the economies are there?

At the close of what probably has been the most disastrous fire season recorded, we face the great unfinished task and unsolved problem—the abolition of forest fires. Why do they still persist, upset our programs, and bring discredit upon our efforts? The answer, of course, is not a simple one, nor the same for every locality, yet one is forced to believe that many responsible and able foresters have not taken the thing seriously enough, have expected the trouble to wear off, the forests to become fireproofed—Heaven only knows how—humanity to yield its habits and interests in a hurry. The one thing that has changed, most happily, is the mind of the thinking public. Its old attitude of indifference has given place to a demand that the fires be stopped. We are faced with a challenge; as foresters and responsible officials are we prepared to accept it or shall we admit defeat?

It is not my purpose to go into details, nor to make recommendations upon this subject, that belongs to those who still are active, but I do venture to affirm that here is the essence of state forestry, and the paramount obligation of every state forestry department. Planting is all right, management is all right, *if* they are subordinated to fire control.

I do not overlook the good work that has been done in several states, the efforts that are being made in others, nor above all, the guidance and material help that comes from Washington. I am simply trying to make it plain that most states will have more fires before they have fewer, that the real fight is just beginning and that anyone who thinks it won is bound to go down. Especially dangerous is it to become confident after one or two, or a few, favorable years. Except, perhaps, in the Gulf States our climate is firebreeding and everywhere our people are careless and indifferent. These facts make it clear to me that we shall never find safety in *suppressing* fires—by whatever means. Whether we like it or not, the job, for our successors, as well as for us, is to create a universal public sentiment against having fires. In a word, prevention, not control. The undertaking is made the harder by the growing number of those who use the forests for recreation. No one wants to restrict that use in the least, rather to extend it in every reasonable, practicable way as the most effective antidote to the evils of our congested city life.

Forest taxation is so distinctly a state function that it must be touched upon here, though it is to be discussed as a special subject. Twenty years ago I knew all about it; what a burden, how inequitable, a prime destroyer, and so on; today I know only that forest taxation is but a little corner of a problem so great and so involved that it has baffled the earth's wisest. Touching, as it does, the sensitive nerve of every individual, the taxing power is at once the state's strength and weakness. Our tax laws are admittedly inequitable, yet few will pretend to find them more inequitable or burdensome in respect to forests than they are in respect to other objects. In fact, it may be doubted whether in most states they do not still favor the forests. Leaving the broad discussion to its appointed place, I venture to question whether the effort at reform should not be undertaken as citizens rather than as foresters. Experience seems to indicate that for every advocate of special classification, or special rates, or deferred payment, on forests and forest land there are 10 opponents who fear that somebody is to be favored. Shall we not more wisely strive first to correct those abuses

that attach to all tax methods, elected local assessors, for instance, to secure more uniform assessments on every kind of property, to establish some principle that will assure an owner of his future, as distinguished from his immediate, obligation. This last is probably the chief concern of most forest owners now; all, however, are of universal application and it is my belief that every effort at special legislation is overhandicapped from the start.

And now, if there shall come to reality—perhaps no further off than the 50th anniversary of this Society—any considerable part of what I have outlined as the probable future of forestry in this country, may we not expect to see most of the establishments requiring crude wood in quantity—pulp mills in the main, located in the sub-arctic, or other regions where civilization is little disposed to compete? For the major part of the enterprise it is not unreasonable to anticipate that what are called the "indirect-returns" will outweigh the "direct returns." In other words, my imagination is not greatly strained by picturing well-kept forests in all parts of the country, their aggregate yield of timber but a fraction of what many men now think needful, yet each satisfying the local demand, exercising every recognized climatic influence, and contributing to the happiness and well being of the neighbors.

FORESTATION RESEARCH IN MONTANA AND NORTH IDAHO[1]

By W. G. Wahlenberg

Forest Examiner, Priest River Forest Experiment Station

Before telling about the forestation activities in this District, I would like to give you a little of the atmosphere of research in general, as it is or as it should be, by repeating some conceptions of it as expressed by others. According to Webster, research is "diligent inquiry or examination in seeking facts or principles; laborious or continued search after the truth." According to R. H. Boerker[2] research is the process by which knowledge is advanced, and the research attitude is an inborn love and enthusiasm for desiring to discover and express the truth. Thus a man who makes investigations or carries on experiments is not necessarily a research man any more than is the man who cuts a tree and plants another, a forester. He should be more.

In order to understand better the purpose and procedure of research, it seems worth while to quote from an editorial in the Experiment Station Record,[3] which, although it deals with agriculture, applies equally well to forestry.

"The reason for agricultural investigation and experiment is that our information may be sound, that reason may prevail, that man may act and conduct his operations rationally. In a large sense it is a study of the relationship of cause and effect. Wherever an effect has been observed there has been a cause, and this cause becomes the object of study. If the purpose is to produce a certain effect, knowledge of the phenomena which cause such effects or influence them must be acquired before the effort becomes more than a hit-or-miss process. The scientific method is that which takes account of all the forces acting. To know the law we must understand the law and this is equally true of a fact, or a spray mixture, or a method of making cheese."

All of this seems to agree with a statement by F. A. Silcox, formerly District Forester, who, when he was asked to give a paper to this Section on the organization of research, did so only after reminding his

[1] A paper delivered before the Northern Rocky Mountain Section of the Society of American Foresters, March 2, 1925.

[2] Boerker, R. H.—Jour. For., Vol. 16, 1918, p. 792.

[3] Experiment Station Record, 36:4, p. 302, 1917.

hearers that in reality "research is a process of thinking rather than a matter of organization."

The object of forestation research is to improve planting practice and further the program for artificial reforestation in any way it can. A few words about this planting activity may be news to some of you. Of some 10,000 acres of land planted annually by the Forest Service, 3,000 to 4,000 are in District 1. At present the planting in this region is confined to the white pine belt, because the largest burned areas in need of reforestation are there, the conditions most favorable to tree growth are there, and because the species chiefly used, western white pine, has the highest commercial value of any of our trees. At present the work is largely confined to double burns, of which 157,000 acres are still in need of planting. Atlhough Nature can usually be depended upon to reforest the single burns in the white pine type, there are 45,000 acres of such land on which natural regeneration is not expected. Thus, there remain over 200,000 acres of National Forest land in need of artificial reforestation in the region. In recent years the planting work has been confined to the St. Joe, Coeur d'Alene, Cabinet, Pend Oreille and Lolo National Forests. Undoubtedly the day is coming when reforestation and even afforestation will be undertaken in eastern Montana. Conditions there are such that every bit of planting lore from our previous experience will be needed to make the work a success. Planting research of today must be worthy of its name in order to be able to meet the demands of tomorrow.

Theoretically the whole District is covered, but practically only that western portion of the District which is now active in planting has yet been considered. Representing this area, three principal experimental centers have been used. The first is at the Priest River Station grounds on the Kaniksu Forest, the second is near Wallace on the Coeur d'Alene, and the third near Haugan on the Lolo Forest. Although the most intensive studies have been confined to these three points, the so-called "administrative" experiments have been scattered over the various areas where planting crews are at work. Most of the studies have been for the purpose of finding methods of obtaining better results or of reducing the costs according to present practice. They have been largely silvical studies falling naturally into three groups: (1) those which deal with seed; (2) nursery problems; and (3) field planting problems.

Four and a half years ago when I was transferred out here from eastern Montana to take over the forestation experiments, there were about 100 separate projects on the slate. This was a result of the early

attempts of all the Western experiment stations to cover their whole field rather completely. Now the policy has been changed to provide for work on only a few projects in order that concentrated effort may be given the most urgent problems. Although much of our present information is fragmentary, due to the scattered efforts of early days, it is worth a brief review, but before attempting such a review, I want to say a little about a very essential element in our experimental methods, namely control.

A perfectly controlled experiment is one from which the action of all undetermined influences capable of affecting results has been excluded. The one thing for which the test was installed remains as a variable so that its effects can be measured. But perfect control is impossible to secure, especially under field conditions. In laboratories and greenhouses better control of certain influences is possible, yet not without the simultaneous introduction of new factors which prevent the results from being directly applicable to field practice. All of our experiments have immediate application in view, so that the actual work of installing them is made much like the usual procedure by administrative agencies on a small scale. In fact, the standard practices, or those in vogue at the time of an experiment, are simulated in the installation of tests. Modifications are desired only in the interests of greater uniformity. For instance, uniformity of site in the field planting tests is always sought though never found. An attempt is made to compensate the effect of unavoidable site irregularities in the average results by splitting up test lots, alternating rows, and sometimes even alternating plants in the rows, to get intimate mixtures throughout the plantation. However, it is recognized that oftentimes all such precautions are inadequate and that other variables remain beyond control. It becomes necessary, therefore, in our work, to provide for lack of perfect control, as well as we can, by multiplying the number of observations used as a basis for conclusions. This in turn necessitates the increase in size of samples of test material,—the number of seeds germinated, the number of trees planted, etc. The greater the lack of uniformity, the larger must be the number of observations made. Within wide limits the effects of many of these troublesome extraneous factors then become compensating.

Without going into the use of higher mathematics and recent developments in what is called statistical methods, how do we know how far we have succeeded in securing control in any case? As in agricultural investigations, it is best to have at least three test lots or plots in

every test involving plant material. Two are to contain the variable under tests and to be exactly alike so far as is possible, and the third is the check or control lot which is the same as the others except for the test variable. Now because of imperfect control the two test lots will differ in behavior and thus provide at least a rough conception of the magnitude of experimental error. Unless some of this difference can be traced to its cause with certainty, it is obvious that no difference of less magnitude between test and check lots has any significance.

Now as to a few results attained, the least has been accomplished with the group of seed studies, and my first example is of an experiment which is not very satisfactory because of poor control. Seven lots of yellow pine plants from different seed sources, including several points west of here, were planted near Haugan. Contrary to expectation the trees from local Lolo seed did least well from the start and were still behind the others five years after planting. Data on the exact locations of seed collection are lacking. Without information as to elevation and parent stands, the present trials are not very useful, but the later records of development should mean more than these early records of survival. With Douglas fir the plants from local Lolo seed survived best, and all sources within the Inland Empire showed four to six times as man living trees in our plantations as did the Pacific Coast varieties.

In methods of seed extraction also very little has been done. We know that temperatures above 115 degrees F. should be avoided in kiln-drying yellow pine,[4] and that temperatures in excess of 120 degrees F. are not safe for white pine. When possible, drying and extraction should be done at ordinary temperatures. Fresh cones collected early in the fall and kept dry yield the best seed.

Germination tests are made annually in the greenhouse as a guide to the proper amounts of seed to sow in the nursery. Spruce seems to do better in the greenhouse than in the nursery, and fir not so well. It is planned to make careful comparisons of such differences, in order to work out correction factors, if possible.

On size of seed, enough has been done to recognize the natural tendency for the larger seeds to produce the stronger plants.

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[4] Temperatures as high as 140 degrees F. have been successfully used in Colorado, when accompanied by free circulation of the air. This note is made to call attention to the fact that temperature can not be considered apart from humidity, in its effect on the seed.—*Ed.*

The nursery studies have gone much further. Proper density in seed-beds, obtained through sowing the correct amount of seed, is important, and should vary with the length of time the trees are to remain in the bed. In transplant rows the development of trees is found to vary inversely with seed-bed density. For 2-0 stock, 5,000 per bed of 48 square feet is the maximum for good plants, and only about 2,400 is the usual aim. With white pine there is clearly a falling-off of features desirable in planting stock when densities in the seed-beds run higher than eight or nine thousand per bed. More observation of the lesser densities is needed.

As to the best time for sowing, fall is the best season for most species. It gives more prompt and complete germination in the spring, as a rule. With yellow pine the policy is to sow in the spring. If field planting is done in the fall, stock from spring sowing is best. Stock from fall sowings is slightly more top-heavy and does not do well when fall-planted. When spring planting is done it seems to make no difference whether the stock used is from spring-sown or fall-sown seed. Spring sowing should be as early in the spring as possible, and fall sowing, if done, should be between September 7 and October 15.

All white pine seed is now sown during the first half of September. The old practice of spring sowing without any previous seed treatment was very unsatisfactory because anywhere from 4 to 91 per cent of the seeds, and usually about 50 per cent, did not germinate until the following year. Many also germinated in the summer and were too weak to withstand sun or frost without protection. The stand was uneven-aged and the stock required heavy culling before planting. By sowing at the proper time in the fall we have eliminated all of these difficulties and the expense of shading and mulching also. In open winters we may experience seed losses from fall sowing, due to adverse conditions for seed resulting from periodic freezing and poor drainage because of a frozen sub-stratum. Spring sowing with some seed treatment, such as stratification, may be the best way to avoid such difficulties.

For covering the seeds after sowing, pure river-washed sand or a mixture of sand and soil is used, because it is not so likely to become surface-hardened and present a mechanical barrier to germination. It must not be too thin or frost may heave the seeds out; nor too thick, or germination will starve. We use a cover of about five-sixteenths inch for yellow pine, about five-eighths for white pine, and one-fourth inch for larch. More experiments may change the figures.

Yellow pine needs no shade. Larch needs no shade until July and August of its first season and none after that. Douglas fir seems to need shade only during unusually hot, dry periods and then quarter shade is sufficient.

Some experiments have been carried out on the proper depth of root-pruning of trees in place. Three inches is too shallow and seven inches too deep for yellow pine stock two to three years old. It should be pruned to a depth of four or five inches at the close of the first season. White pine responds in much the same way.

In the early days experiments were resorted to in order to find satisfactory methods of planting with the new one-hand mattock—methods which would enable one man to do as much as the old two-man planting crew. The most careful method tested was the cone method; quicker methods were the center-of-hole, the prepared-side-of-hole, the side-of-hole, and the slit method. With white pine, at least, the best results were obtained with the cone method and the poorest with the rapid slit method, but the difference was not enough in favor of the careful methods to justify the additional cost. Yellow pine seemed less exacting and showed very little difference in survival between hole and slit methods of planting, and under favorable conditions it seems to make no difference to either species how the trees are planted so long as the roots are brought into firm contact with moist mineral soil. More careful methods, such as the cone method, may be ideal from the standpoint of survival regardless of cost, but when the object is to obtain the largest number of living trees per dollar invested, the slit method has been found most efficient. If it is shown that the slit method is subjecting the trees to dangers such as root rot and windfall in their later life, the method can no longer be considered efficient.

A few experiments and several years of planting practice indicate that no great difference is to be expected between spring and fall plantings for an average year. The cold nights and warm days of an "Indian summer" following fall planting seem detrimental, but if such weather does not intervene between the time of planting and winter, there may be an advantage in fall planting over that of the following spring.

Success in direct seeding has been the exception and failure the rule. Douglas fir did the best of all species in these experiments but it yielded survivors in less than 20 per cent of the spots. Rodents were the chief cause of loss of the larger seeds, but drought caused more damage than any other two causes. During the summer the soil dries

out completely to a depth greater than the roots have been able to penetrate, and high evaporation rates at the same time soon kill the trees. Cutworms destroyed many trees, frost some, and fungus a few. The best hope for direct seeding seems to lie in sowing on fresh ashes in large burned areas before the rodents learn of the presence of the seed. The sowing of cedar seeds in specially protected spots is being tried.

Among the most important planting problems has been that of finding the most suitable classes of stock for use on different aspects or exposures. In general, the northerly and easterly slopes are most favorable and are planted to white pine; the southerly and westerly slopes are severe and are planted to yellow pine. As to age class, transplants are usually superior to seedlings and the older superior to the younger stock. White pine age classes, for instance, arrange themselves as follows: 2-2, 1-2, 2-1, 2-0 and 1-1. Among trees of the same age, the larger ones are the best. This was somewhat of a surprise, because we first thought that the smaller ones would do equally well if they were not top-heavy. That is not the case, at least with our slit method of planting, probably because the greater stiffness of lateral roots on the larger trees results in a better distribution in the soil.

There are some interesting points in E. C. Roger's work with these white pine age classes at Wallace. The study involved the planting of 12,000 trees—600 plants of each age class on each of four aspects, N. W., N. E., E. and W. Factors favoring good control were the uniform slopes, near together and at the same elevation; the fact that the planting was finished in less than a week; and the arrangement for each planter to plant an equal number of trees in each lot. All dead trees were dug up at the close of the season and examined for evidence of the cause of death. Among the contributing causes were roots stripped, scraped, or cut too short; trees set too high or low or in poor places, as under logs or on up-turned roots, biotic injuries and burying by sliding soil. Such cases constituted only about 10 per cent of the total dead, and the remaining 90 per cent seemed to have died from drought alone. It is interesting to note that the difference in survival between the best and the poorest stock varied directly with the severity of the site. More surprising, perhaps, is that the poorest survival was accompanied by the most rapid growth and vice versa. This does not seem to be due to the survival of relatively more inferior plants on the favorable sites. It is possible that increased growth is related to increased transpiration on the severe sites.

Root length has been found important. Tests of roots from 4 to 10 inches long, indicate regular increases in survival with root length.

What we call balance, or the ratio between the transpiring surface of tops and the absorbing surface of roots, is important. Transplants tend to have better balance than seedlings, that is, the tops are relatively small in proportion to the roots. The use of longer roots carries with it an improvement in balance, which seems to be more than proportional to the additional root length. By less severe pruning root sections are retained which are active absorbing organs due to their thin bark. The abundance of root hairs on white pine roots less than one milimeter in diameter also greatly increases the absorbing surface, but their normal function after planting is not certainly known.

A few trials have been made with top-pruning as a means of improving balance, and through it increasing field survival, but as yet we have no assurance of success in this attempt. Although we have spent comparatively little time and effort on this idea, it is of especial physiological interest and may therefore justify further discussion. In the trials already made, yellow pine stock was needle-pruned with shears in such a way as to remove with a single cut about one-third of its crown without injury to the terminal bud. No excessive bleeding of sap occurred, the wounds sealing themselves promptly. It seems likely that the resinous nature of the cell sap was what checked excretion. The leaf tissue died only about one-sixteenth inch back from the cut ends. In this test, however, which did not have a large basis in number of trees, the pruning seemed to be detrimental to thrift and survival, except in the case of the larger trees which were necessarily pruned less severely in order to preserve the buds. It must be remembered that when we reduce transpiration in this way we also reduce the organs of photosynthesis, and that at the very time of year when synthesis of plant food is normally most active. In cutting needles before planting and at the beginning of the spring period of rapid growth, it would seem that we are not only reducing photosynthesis when most beneficial, but are reducing transpiration when least harmful. Of course, it would be as much out of the question to plant and then return to prune the trees a month or two later as it would be to go back and water them, but Nature seems to pull some trees through drought in much this way. With the constant reduction of the supply of available soil moisture as the summer season progresses, the needles of the previous season commonly turn brown at the tips, the remaining tissue being apparently in good functioning condition, but diminishing in amount as the dead tis-

sue at the tip advances. If the drought is not too long or severe, many of these trees live without any loss of thrift in the needles of the current season and with no apparent retardation of height growth. It looks as if Nature had retained foliage for photosynthetic purposes in the spring, and then in her later rejection of leaf tissue had been careful not to abandon any of it until absolutely necessary to life. However, judging by the large number of trees which die in spite of this natural precaution, it seems that there may be a chance of saving more of the vigorous trees by artificial pruning when planting and cutting are not done too early in the spring. Such a possibility should be investigated, but not at the expense of what are perhaps better chances of reducing top-root ratios by the improvement of root systems in the nursery—the possibility of so modifying root form as to increase the amount of active absorbing root surface at the deeper levels within the root zone.

I have been speaking of the past work in silvical or silvicultural research for the benefit of forestation. There are other lines of study which may be developed in the future to further the same general cause. One is meteorological studies. Some day we may be able to predict destructive frost-heaving in the nursery and protect against it as successfully as the California fruit growers now predict frost and save their fruit from injury. But the biggest thing in this field would be long-time prediction of the occurrence of dry years. Were this possible, planting could be restricted to the most favorable sites in dry years or entirely suspended. The extended use of planting funds in moist years only would greatly increase survival. Another field is that of economic study. An analysis of costs and efficiency in the application of present knowledge and in general administration might be productive. In engineering studies there is the possibility of more new mechanical devices, although considerable advance has already been made in this direction.

In the old field of silvical study many useful things remain unknown. The determination of the exact requirements of each tree species and exact methods of interpreting site factors, or Nature's ability to meet these requirements under different conditions, is a broad ecological problem which will require long-time cooperative effort for its solution, but which will further our knowledge of natural, as well as artificial, processes of reproduction. At present the study of the minor tree species is being neglected in favor of the white and yellow pine and Engelmann spruce. As forestry practice becomes more intensive there will be need for more information on all species, and on such subjects

as spacing and mixtures in plantations, possible connection between planting and damage in later life from root-rot, windfall, etc. Genetics, a rapidly developing science, may lead to new information in regard to seed production. In fact, there is no end of progress which may be made through the various branches of science. As someone has said, it is a poor thought that there could be an end.

I have given the high spots of some of the results attained and a little about the methods used. I have mentioned some things we have learned and some things which we should know but do not.

Now I should like to mention the principal steps, as I see them, in the solution or attempted solution of problems by research. All of these steps apply to forestation investigations and in a general way would probably apply to most any line of research. Therefore, please forget the Forest Service for a moment and consider yourself an outsider thinking only of desirable means of solving a problem.

A prerequisite, of course, is a man of research type mentally, with some foundation, in education or experience or both, for the work he takes up, and with a will to add constantly to whatever education he may have been fortunate enough to have acquired previously. His *first* step is to connect himself with some permanent organization suitable to give his work scientific support and make permanent records of results. *Second,* he must get posted as well as possible on all existing knowledge of the subject and on circumstances affecting the problem. Some industrial organizations in giving a man a new assignment in the field of research expect no actual results for a period of about five years. Before starting work time is taken to view the problem from many angles and to study all available sources of information bearing on the problem. *Third,* there must be more or less definite plans of procedure. *Fourth,* the installation of tests starts the actual experiments. *Fifth* comes observation of natural phenomena in connection with the tests. Here I refer principally to organized observations which usually include such tasks as counts, measurements and weights, systematically taken and recorded, rather than to general observation, which, like education, should be continuous. *Sixth* is the compilation of all pertinent data—bibliographical, numerical and descriptive. *Seventh* is interpretation. Someone must assign a meaning to the whole thing before it can be applied. There may be no results due to an inadequate basis for observation and experimental errors larger than any effects traceable to their causes. Results may be incomplete and have meaning only in connection with additional work. Then again results may be adequate and

either positive or negative[5] in character. Most of these elements are present in the interpretation of any experiment. *Eighth* is verification, the drawing on additional facts from past, present or future work to increase the certainty of conclusions. And *lastly* is publication. In the case of long studies this should be periodic rather than merely the last step, and, of course, in no case can it be considered absolutely final. Also, publication may not be necessary to your employer but it is essential for the best interests of science.

To repeat, we have these steps which seem to me to be the logical procedure in the solution of research problems: *Organization*—join it; *Information*—get it; *Plans*—make them; *Installation*—start the work; *Observation*—watch what happens; *Compilation*—sum up what you have learned; *Interpretation*—figure out what it means; *Verification*—make sure of your stand; and *Publication*—tell the world.

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[5] The author uses "negative" in a not commonly-accepted sense, the latter being the sense in which he speaks of "no results" just above. In science results are not negative because they contradict preconceived notions, but only when they fail to prove the doubtful point in any manner.—*Ed.*

VARIATION IN STAND AS FACTOR IN ACCURACY OF ESTIMATE

By W. G. Wright

Price Brothers & Co., Ltd., Quebec

In any estimate of standing timber based on sample areas, there are, apart from personal errors—with which errors due to faulty volume tables may be classed—two main factors which influence the accuracy of the estimate; the total area of samples taken and the degree of variation in the volumes of the sample areas; the first is a function of the size of the area estimated and the percentage of cruise, and the second is a function of the variation in the stand of timber and of the size of the individual sample areas. Errors due to the personal factor, as far as they are biased, can only be eliminated by employment of efficient personnel, and by the use of correct volume tables; this paper does not make any attempt to examine the effect of such errors. Errors in the volumes of the sample areas due to the personal factor, as far as they are compensating, may be considered with the variations due to the character of the timber or the size of the individual sample areas.

It will be noted that each of the factors under consideration comprises two sub-factors; in each case, one sub-factor can be controlled and the other not. The problem, in any decision as to intensity of cruise to be adopted, is to modify the controllable factors—size of sample areas and percentage of cruise—to correspond with the non-controllable factors.

THE TOTAL AREA OF SAMPLES TAKEN

Suppose, for example, the estimate is to be based on quarter acre plots at ten chain intervals on compass lines ten chains apart; a 2½ per cent cruise.

In the general run of pulpwood timber in the East, the stand is liable to as much variation over 50 acres as over 5, 10 or more square miles; in small or in large areas, the stand may vary anywhere between the heaviest stand and a blank. This being the case, an estimate on 40 acres, based on 4 quarter-acre plots, is subject to very considerable error, since these 4 plots can not be expected to cover all possible variations in stand on the area.

Note.—The writer is indebted to Mr. D. E. Lauderburn of the Pejepscot Company, Brunswick, Maine, for the material used in the examples shown in Tables I and II, and for some suggestions in connection with the work.

The greater the area, the larger the number of sample plots and the more chance there is of the variations in stand over the whole area being represented by the sample plots measured, with the result that the average of the plots—the estimated stand per acre—may be expected to be more accurate over a large area than over a small area.

It would appear, therefore, that other things being equal, if we wish to secure a given degree of accuracy in an estimate, we must cruise a larger percentage on a small area than on a larger area.

DEGREE OF VARIATION IN THE STAND ON THE SAMPLE AREAS

Measurement of small sample plots may be expected to give a greater variation in the volumes throughout the plots measured than does measurement of larger plots, since in the large plots the extreme tend to be reduced.

The other factors influencing the variation of the stand, on the sample plots, is the variation in stand over the whole area estimated. In actual practice, this variation in the stand over the whole area is expressed by the variation in the sample plots taken.

It is clear that, with a given number of sample plots, the average, that is the estimate, will be more accurate in regular than in irregular timber, so that if we want a certain degree of accuracy, we must make the number of our plots correspond with the degree of regularity, or degree of variation, in the timber to be estimated. This degree of variation can be referred to a standard, that is, it can be measured, and it is the purpose of this paper to show how this measurement is made and how the method can be applied commercially.

MEASUREMENT OF DEGREE OF VARIATION

The following example will serve as a basis for explanation.

In a certain area of about 1,600 acres, there are two main types, over-mature spruce with balsam fir (type A) and younger thrifty growth of the same species (type B). For silvicultural reasons, it was desired to secure a separate estimate for the areas occupied by these two types.

The line and plot method was selected; a 2½ per cent cruise was made, based on quarter-acre plots at 10 chain intervals on cruise lines 10 chains apart. The cruise showed about 900 acres with 92 sample plots in type A, and about 700 acres with 72 plots in type B.

The sample plots measured on a given area for any one type may be arranged in series according to density of stand, those plots with

the heaviest stand at one end and those with the most open stand at the other. In any such series, it will generally be found that there are only a few plots at the extremes and that as the central point of the series is reached, the number of plots of approximately equal volume tends to increase. Tables I and II show such series of plots, the plots being arranged according to the number of cords per quarter acre, and being grouped in half-cord classes.

The number of plots in any one volume class is termed the frequency of that class, the whole series is termed a frequency group and the manner in which the plots are distributed among the volume classes is termed the frequency distribution or dispersion. This dispersion is simply the degree of variation and the standard deviation may be used as the measure of this dispersion.

Where: s = standard deviation
Σ = sum of
d = deviation of any one measurement from the arithmetic average or from an arbitrary origin.
d_o = difference between arbitrary origin and arithmetic average.
n = number of measurements.
Then:

$$s = \pm \sqrt{\frac{\Sigma d^2}{n - 1} - d_o^2}$$

Tables I and II show the calculation of the average and standard deviation for types A and B respectively, the estimates being for the whole area of each type in both cases.

Other things being equal, the standard deviation is less in regular than in irregular timber.

CALCULATION OF ACCURACY OF ESTIMATED STAND PER ACRE

The average of a number of samples measured is intended to represent the true average of the material from which the samples are drawn. The degree to which the observed average approximates to the true average, varies with the standard deviation (the degree of variation) and the number of samples taken. The accuracy of the estimate (as far as affected by the variation in the stand) may be expressed by the standard error, which is the standard deviation divided by the square root of the number of sample plots taken; e. g., in type A, the standard error is,

$$\pm 6.0 \div \sqrt{92} = \pm .62.$$

TABLE I.

DISPERSION OF VOLUMES IN CORDS PER QUARTER ACRE

Type A

Total Cords per Quarter Acre	Frequency	Deviation from origin 3.3 : $d_o = .2$					
	n	d	d x n	d—	d— x n	d^2	d^2 x n
.3	2			3.0	6.0	9.00	18.00
.8	3			2.5	7.5	6.25	18.75
1.3	9			2.0	18.0	4.00	36.00
1.8	14			1.5	21.0	2.25	31.50
2.3	5			1.0	5.0	1.00	5.00
2.8	12			.5	6.0	.25	3.00
3.3	18						
3.8	5	.5	2.5			.25	1.25
4.3	7	1.0	7.0			1.00	7.00
4.8	2	1.5	3.0			2.25	4.50
5.3	8	2.0	16.0			4.00	32.00
5.8	3	2.5	7.5			6.25	18.75
6.3	3	3.0	9.0			9.00	27.00
6.8							
7.3	1	4.0	4.0			16.00	16.00
	92		49.0		63.5		218.75

Mean $= 3.3 - \frac{63.5 - 49.0}{92} = 3.1$ cords per quarter acre.

Standard Deviation $= \pm \sqrt{\frac{218.75}{91}} - .2^2 = \pm 1.5$ cords per quarter acre.

TABLE II.

DISPERSION OF VOLUMES IN CORDS PER QUARTER ACRE

Type B

Total Cords per Quarter Acre	Frequency	Deviations from origin 3.8 : $d_o = .1$					
	n	d	d x n	d—	d— x n	d^2	d^2 x n
1.3	6			2.5	15.0	6.25	37.50
1.8	5			2.0	10.0	4.00	20.00
2.3	10			1.5	15.0	2.25	22.50
2.8	6			1.0	6.0	1.00	6.00
3.3	9			.5	4.5	.25	2.25
3.8	9						
4.3	7	.5	3.5			.25	1.75
4.8	5	1.0	5.0			1.00	5.00
5.3	4	1.5	6.0			2.25	9.00
5.8	5	2.0	10.0			4.00	20.00
6.3	1	2.5	2.5			6.25	6.25
6.8	3	3.0	9.0			9.00	27.00
7.3	2	3.5	7.0			12.25	24.50
	72		43.0		50.5		181.75

$$\text{Mean} = 3.8 - \frac{50.5 - 43.0}{72} = 3.7 \text{ cords per quarter acre.}$$

$$\text{Standard Deviation} = \pm \sqrt{\frac{181.75}{71}} - .1^2 = \pm 1.6 \text{ cords per quarter acre.}$$

It can be shown that the extreme of error we are subject to in any average is three times the standard error; this may be termed the limit of error, and while the average of 12 cords per acre may be considered fairly close to the true average, it is certainly not more than about 2 cords (.62 x 3 cords) from the true average, or about 15 per cent.

It can be shown, further, that we are unlikely to have an error greater than twice the standard error; the chances are only 1 in 20 that the error in our observed average (i. e., our estimate) is twice the standard error. The chance that the error reaches three times the standard error is only 1 in 370. This scale of chances can be given consideration in any examination of the accuracy of an estimate.

CALCULATION OF NUMBER OF PLOTS FOR GIVEN DEGREE OF ACCURACY

If it is considered that a precision, or limit of error of 15 per cent as above noted is not satisfactory, we can readily calculate the number of sample plots required to secure any given precision.

If we decide that the limit of error shall not exceed 5 per cent, the standard error must not exceed one-third of this, or 1.7 per cent. In type A, this is equivalent to a standard error of 0.21 cords per acre.

If the standard error equals the standard deviation divided by the square root of the number of sample plots, then the number of sample plots required for a standard error of $\pm$ .21 cords per acre with a standard deviation of $\pm$ 6.0 cords per acre, is:

$$\frac{(6.0)^2}{(.21)} = 840$$

Similarly, it can be shown that the number of sample plots required for a maximum error of 10 per cent in that type is 210.

The practical application of such a calculation as this would consist in making the total number of sample plots on the area to be estimated correspond to the degree of accuracy required, the distance between compass lines would depend mainly on the accuracy necessary in mapping topography and boundaries of types; the interval between sample plots on the compass lines would be made to correspond with the total number of plots required.

ACCURACY OF ESTIMATE ON LARGE AREAS

The illustration given above has dealt with a 2½ per cent estimate for one type on an area of a little over a square mile. If, now, the unit

area for which we require an estimate is a watershed of 25 square miles or so, and if we are not concerned with separate estimates for the different small parts making up the 25 square miles there seems to be hardly any need to make so detailed a cruise.

The following table shows the standard errors in the stand per acre for different percentage cruises on 25 square miles, a standard deviation of $\pm$ 7 cords being used.

Percentage Cruised	Number of Sample Plots on 25 Square Miles	Standard Error Cords per Acre
2.5	1600	.17
0.6	400	.35
0.15	100	.70

The standard error being the measure of precision, it will be noted that the precision is four times as great for 16 times the number of measurements or twice as great for four times the number of measurements. In view of this relation between number of plots and accuracy, and in view of other errors affecting the final estimate—mapping of types or watersheds, for example—it may be more satisfactory to base the estimate of stand per acre on 25 square miles on a 0.15 per cent cruise, or perhaps even less.

A test was made of this in connection with some other work. A strip survey was run over an area of about 20 square miles of poor timber; strips were 33 feet wide at one-half mile intervals, the trees on each two chains being tallied separately. The tally covered softwood, mixed wood, black spruce and barren.

Seven independent estimates were made from this strip survey. The first estimate was based on the first six chains in each half mile of strip, the second estimate on the second six chains in each half mile of strip, the third, fourth, fifth and sixth estimates on the corresponding six chains on each half mile; the seventh estimate was based on the last four chains in each half mile. So that six estimates were made up, each based on sample plots of three-tenths of an acre and one estimate on plots of one-fifth of an acre; in all cases the plots were at half mile intervals on lines half a mile apart. The seven independent estimates were compared with the estimate based on the continuous strips; it was found that one of the seven estimates differed from the estimate from the whole tally by 0.5 cords per acre, and the other six differed by 0.25 cords or less.

The standard deviation of the volumes on all the plots measured on the area was found to be ± 3.8 cords per acre; for an estimate based on 70 plots, the standard error in the average stand per acre would be ± .46 cords. As has been noted, the chance of the error in an average being twice the standard error is 1 in 20, and it will be seen that none of the seven independent estimates made in this case reaches this limit.

ACCURACY OF ESTIMATE ON VERY SMALL AREA

As we have noted, the number of plots can be made to correspond with the accuracy required. If it is not feasible to measure sufficient plots to give the desired accuracy, on a very small area, it will be necessary to supplement the work by ocular estimate; by comparison of the stand on the plots measured with the surrounding timber, for example.

CONCLUSION

The main requirements in the use of these methods in examining the accuracy of an estimate is to have a reliable figure for standard deviation.

The writer has made some measurements of standard deviation in pulpwood stands in seven localities; these are given below.

Locality	Stand Per Acre Cords	Standard Deviation Cords per Acre
1	15	6.4
2	13	6.4
3	9	6.6
4	8	3.8
5	6	2.8
6	4	3.8
7	3	2.7

We may expect to find greater variation in the stand per acre in heavy stands than in light stands, and this seems to be borne out by the above figures. These figures may be used as a guide in determining what percentage of cruise is necessary on a given area, though conclusions based on them might be subject to modification as further material accumulates.

WHAT IS A CORD?

By R. S. Kellogg

Kirkland's excellent paper, "The Supply of and Demand for Timber," presented at the annual meeting of the Society and printed in the May-June Journal of Forestry, very properly suggests the adoption of uniform units of measurement in the compilation of statistics of forest products. Without such uniformity, comparisons are worthless.

Very naturally, Kirkland suggests that the unit adopted be the "cord" for a large variety of material, for much of which the cord is the historic unit. However, many of the foresters, engineers, accountants and others in the pulp and paper industry, whose operations require exactness in quantity, are getting away from the term "cord" as rapidly as possible. In order to explain the reasons therefor in some detail, I take the liberty of quoting as follows from a previously published statement of my own on this subject:

"When not scaled by log rules, pulpwood is usually measured in 'cords,' a cord being the amount of wood that can be stacked in a space 8 ft. long, 4 ft. wide and 4 ft. high, or the equivalent of 128 cu. ft. of space. There is certainly no reason why the cord any more than a thousand board feet should be the unit for pulp wood measurements, and neither is adapted to the real needs of the processes and the product involved.

"But a cord never contains 128 cu. ft. of solid wood, because round pegs do not fit square holes. Wood is never symmetrical in form, and there is great variation in content depending upon size. In actual practice, therefore, a 'cord' of wood may contain as little as 70 cu. ft. or as much as 100 cu. ft. of solid wood. An actual content of 90 cu. ft. of solid wood per commercial cord is probably not far out of the way in the average case.

"It should be noted here that the French cord in Quebec is 8 ft. 6 in. by 4 ft. by 4 ft. 3 in., with a total volume of 144 cu. ft., and occasionally other local variations are met. However, in ordinary parlance, a cord means the equivalent of a volume of 128 cu. ft.

"There are other complications. A cord of wood may be rough, peeled or rossed, with corresponding variations in actual volume. A cord of wood with the bark on, may shrink in volume as much as 15 per cent when peeled by hand or drum barked and as much as 25 per cent when rossed, as the knives which remove the bark also cut away some wood, no matter how carefully the rossing operation is carried on.

"Conversely, a cord of peeled wood contains more wood than a cord of rough wood and a cord of rossed wood more wood fiber than a cord of peeled wood because wood thus prepared stacks more closely. Such differences in the condition of wood account to quite an extent for the variation in reports as to the yield of pulp per cord of wood by various processes. No real comparisons can be made unless the same kind of a 'cord' is dealt with.

"But there is still another confusion in pulpwood measurements. In many instances, pulpwood is cut and transported to the mill by water or rail in the form of logs (sometimes tree-length) and in the woods operations is scaled in thousand board feet by one of the numerous log rules. Then for mill operations the log scale is converted into cords, the conversion factor varying according to locality, character of timber and scale used. In the East, 1,000 ft. log scale is generally assumed to be equivalent to two cords of wood or 500 bd. ft. per cord. In some places, however, a cord is assumed to equal 550 or 600 bd. ft., while on the Pacific Coast, a converting factor of 700 or 750 bd. ft. per cord is used in some cases. In Quebec the legal equivalents are 600 bd. ft. for a cord of rough wood and 700 bd. ft. for a cord of rossed wood. (A recent Quebec order-in-council changed the equivalent of a cord of rough wood to 500 bd. ft.)

"As noted previously, there is nothing in the pulp making processes that in any way renders the cord, board foot or any other volume measurement the most suitable unit for raw material. It is wholly a question of expediency, influenced by methods inherited from other days and other types of wood utilization.

"Some paper mill managements have adopted 100 solid cu. ft. of pulpwood as their working unit, and this is a great improvement over the haphazard cord where accurate scaling can be enforced. Perhaps the best that can be hoped for in this direction is the development of an automatic scaling device which will continuously record the volume of pulpwood as it passes along a conveyor on the way to grinder or chipper.

"But the fundamental difficulty is that except for wood, all material that enters into paper making is measured by weight instead of volume and this is true also of the finished product. Obviously there can be no accurate checking of product against raw material and consequent complete determination of conversion losses when the material is measured by volume and the product by weight.

"The theoretically correct method is to weigh all wood into the mill

with sufficient sampling to determine the percentage of moisture it contains. Only in this way is it possible to know exactly how much wood fiber there is to start with and to check against it the amount that comes out in the form of pulp or paper. A few manufacturers of chemical pulp are already doing this through the use of a device which automatically weighs and records the weight of the chips of wood as they are carried on a belt conveyor. Samples of the chips are frequently tested for moisture, and in this way the amount of wood fiber used is accurately and constantly known."

As a further step in the adoption of a standard basis for comparison, it is interesting to note that a number of manufacturers of news print paper who conduct their own logging operations are exchanging information upon logging costs with a view to increasing the efficiency of their operations. The unit of pulpwood production adopted for the purpose of this exchange is the "cunit," a cunit being 100 solid cubic feet of pulpwood. The term was derived by adding "C," representing 100, to the word "unit." The Manual of Instructions supplied by the News Print Service Bureau to the companies participating in the exchange of information contains the following instructions under the heading of "Production Unit":

"For the purpose of comparison, it is necessary to use a common unit of production as a basis for all reports. This unit is '100 solid cubic feet' termed a 'cunit.'

"The computation of the solid cubic feet of long logs should, whenever possible, be based on top diameters and lengths as shown by scalers' reports. Conversion tables are available for this purpose.

"If a log scale is used and no top diameters are recorded, 'board feet' must be converted to 'cunits' for the operations covered by the cost report. The converting factor will vary with the type of timber and the log scale used.

"Where pulpwood is measured in cords, the figures for reporting purposes must also be converted to 'cunits.'

"Operators in different sections should establish their own conversion tables based upon local conditions for which purpose the Bureau will assist in securing any available additional information."

Many other forest products besides pulpwood can now be measured in accurate units and if we ever come to really close timber utilization in the United States, we shall get upon a basis of actual wood volume, rather than a mythical one which, in addition to being mythical, is never the same myth twice.

FOREST MANAGEMENT AS PRACTICED BY THE PEJEPSCOT PAPER COMPANY*

By D. E. Lauderburn

Consulting Forest Engineer to the Pejepscot Paper Co. and the James Maclaren Co.

I have been asked to prepare a paper on the activities and plans of the Pejepscot Paper Company as regards the management of their forests. I hope you are not expecting a treatise on silviculture. The recognition of silviculture and its application is very important; but starting as we have on this continent with large areas of timberlands almost entirely uncultured and managed as secondary investments to provide raw materials for primary investments in mills and factories, we are greatly handicapped in developing those methods of management which are most effective from the point of view of forest productivity alone. Hardly a move is made in a paper or pulp mill without calling on engineers for technical advice. I have felt that technical advice is of similar importance in the woods and have stressed the value of obtaining the counsel of the forester in the management of the woodlands. This means that the foresters must form an integral part of the department in charge of the forest lands and forest operations, in our case called the Department of Woodlands. Therefore, I have studiously avoided the formation of a separate department for the technical staff, or anything approaching it. As ours is a comparatively new profession on this continent, I feel that it is very important that we get started right. It is a natural tendency that any new group coming into an existing organization should be formed into a separate department. It may seem, from a superficial view, to strengthen any such new group of men, in this case the foresters and their assistants, to form them into an efficient, self-sufficient unit, working effectively at whatever duties may be assigned to them, for the most part cruising, mapping, planting or research. But in the organization of a so-called "Forestry Department" or anything that tends to group the technical staff, we overlook the fact that a large part of the work of a new profession is educational. Therefore, it has seemed to me desirable to make some sacrifice in the efficiency of the foresters of the company which might

*Presented at Annual Meeting of The Canadian Society of Forest Engineers, Ottawa, Jan. 28, 1925.

be furthered by their working together as a group, in order to scatter them through the organization where they can fulfill their educational function by direct contact with the managing staff. Also, it must be remembered that while the forester has a great deal to teach, he also has a great deal to learn in the actual business of forest administration. Thus, the scattering of the foresters through the staff is mutually beneficial to the forester and to the men with whom he is in contact, that is, the general and local managers, camp foremen, jobbers, pulp mill superintendents, sawyers and so on down to the lumberjacks. The result with the Pejepscot has been a forest engineer in the head office in direct contact with the manager of the Department of Woodlands and foresters in the woods as assistants to the local manager. Of course the Chief Forester does not stay in the office all the time. Like the manager of the Department, he goes to the woods to keep in touch with the operations, to study conditions at first hand and to give technical advice to the foresters and local managers.

What has been the result of thus scattering the technical men throughout the staff? We have a business organization, a business-trained brain at the head. Working with him is the technically-trained man. Both have a certain part of the responsibility. While the business man is at fault if the business practice is not sound, in the same way the forester must feel that the responsibility rests directly on him if he does not keep the manager fully informed on all technical points. The business manager asks the forester for advice; but the forester's duties do not end there. Sometimes the initiative must come from the forester. His experience, observations or research may suggest certain procedures to be desirable. It is then up to him to "sell" his ideas to the manager or become convinced that he is wrong. He must feel his responsibility as a forester and can not permit mismanagement of the company's forests when technical considerations are the deciding factors. A few examples may show how this kind of management has worked.

The primary problem was to see that there was a continuous supply of raw material for the pulp mills for an indefinite period into the future. Here was something which could not be decided alone by the manager. The forester was instructed to study the situation and report. At the same time the manager studied the problem from his point of view. Result: One stumpage permit terminated because of excessive cost. One operation on company lands closed down because the lands were too hard cut, trees mostly under 12 inches

diameter, land well stocked. This property is being held for recovery and growth for a decade or two. Another property was found to be very largely hardwood land and rather small for an operating unit. It might be operated for a continuous yield of five or six thousand cords; but driving, loading and shipping facilities permitted operations up to ten or twelve thousand cords per year. The hardwoods were accessible. Although moderately well stocked with young softwoods it was not as well stocked as the other properties. It had been operated during the previous decade on the basis of continuous yield, leaving 5, 6 and 7 inch softwoods for future cutting. It was decided that the best policy would be to strip this property of softwoods, change the tract into a hardwood forest, with the option, a decade or two hence of converting it from a hardwood forest to farm land or of stripping it of hardwoods and planting to softwoods.

A third tract had been operated very conservatively for many decades. It was a splendid softwood property, well stocked, excellent reproduction, accessible, fire risk not excessive. It had been cut to a high diameter limit. Reproduction of spruce and fir had been established in abundance as a result of the light cutting. In some localities there had been no recent cutting and the forest had reverted to its virgin condition, a stand of large spruce with insufficient reproduction, much suppressed. The yield in trees of log size had been estimated at 15,000 cords per year. It was decided that this tract should be cut to as small a diameter as could be used for pulpwood and thus liberate the advance growth already established and convert the forest from a rotation of 150 years or more in saw log trees to one of 40 to 80 years of trees of pulpwood size. This will mean cutting more than the annual yield for one or two decades, then reduction of the cut for a period. Eventually it is expected that the yield will be greatly increased by this treatment, very likely doubled. Such parts as are in a virgin condition will be opened up by light cutting and then the balance of the old growth removed to free advance growth after it is established.

No one of these tracts could be considered solely from the silvicultural point of view. The pulpwood requirements of the mills were the primary consideration. But, as far as possible, the properties are managed for what they are best fitted to produce. A hard cut property is resting and growing while an undercut property is being cut hard to free the advance growth, which will eventually increase

its annual yield. Also other factors, such as overhead expenses, consolidation of properties, etc., entered into the decisions.

I might cite one instance of change in method of operation in which the initiative came from the forester. In the case of the good spruce property, mentioned above, only the larger trees were being cut and were being taken out as logs. An examination of the tract showed that it was eminently fitted for a four-foot wood operation. There were many small streams that would carry four-foot wood, but were too small to float logs. Thus, the haul could be reduced from several miles to a mile or less, fewer dams were needed, the capacity of the streams was greatly increased, the cost of driving reduced. At the same time, the change in method of operating fitted in with the decision to cut closer and take smaller trees and at the same time salvage budworm-killed timber to as small a size as could be used. The greatest advantage in the change of method, perhaps, was the saving of wood material. Utilization is always closer in a four-foot than in a log operation. Sound four-foot sticks can be taken from defective trees, especially firs, affected by heart rot and many small pieces which can not be handled economically in a log operation were saved.

Another instance will illustrate the application of technical advice in forest management. A study of the lumber market indicated that a hardwood operation for the production of lumber for the wholesale lumber market would be profitable. Here the initiative came from the business mind; but certain technical problems had to be decided. The area to be cut for hardwoods had been cut for softwoods some 10 to 15 years before. The hemlock had been left and the spruce, fir and cedar had not been cut clean. A considerable stand of softwoods was left. Should these be cut with the hardwoods? Should they be left and the present cut be confined to hardwoods? Certain factors affected the decision. It was evident that there was little if any profit in hemlock lumber. Growth studies had shown that where hardwoods had been cut, the rate of growth of the liberated softwoods was greatly increased. There was a drivable stream; but the hardwoods must be hauled to the sawmill. It became apparent that the logical and profitable thing to do was to cut hardwoods only, with the exception of dead softwood trees and those broken by felling the large hardwoods. Then, at some future period, a pulpwood and tie operation can take out the spruce, fir, hemlock and cedar. Meanwhile the growth will have been stimulated and the amount of softwood

pulpwood will have increased considerably, far more than if the hardwoods had not been cut. This was an instance where the business and technically trained minds worked together to solve a problem in management.

While the manager and forest engineer are working on the major problems of management, the local managers and local foresters are working at the routine of getting out the annual cut of pulpwood and sawlogs and protecting the timber from fire, insects and trespass. Here the local forester is technical assistant to the local manager. The local manager can not attend to all details himself and it is desirable for him to have a technically-trained assistant, rather than a man who has had only so-called "practical" experience. The forester assists in locating jobbers, preparing jobber's contracts. He inspects the operations to see that the logging regulations are complied with. He is responsible for the line work and forest inventory. He watches for insect outbreaks. He assists and advises the manager in planning the fire prevention system and keeping it effective. He gathers any forest data especially needed and does some research work when any specific problem requires study. Of course, such of his work as is outside of the regular routine is frequently initiated at the head office. Here, however, is the distinction between the organization as we have developed it and a separate "Forestry Department." If the head office requires certain data the instructions are not given directly to the local forester. The need for the data may be discussed with the local manager and he may be instructed to use his forester in gathering it. If definite technical instructions are sent from the head office to the local forester, they are sent to the local manager for the attention of the forester. Thus the manager has direct charge of all that is going on in his forest. He learns something about silviculture, entomology, mensuration or at least he finds out that there are some things he does not understand and that his technical advisor can supplement his own knowledge of the woods. Meanwhile, the forester, in direct contact with the man in charge of the woods operations, working with him, sympathizing with the many practical difficulties with which he has to contend, and at the same time not forgetting that he is a forester and that his education and his connection with this profession should give him a vision which the practically trained man may lack, is learning far more and becoming more valuable than if he were isolated in an organization attending only to technical details.

There is another function which the forester fulfills which is of very considerable importance. He acts as a liaison officer between the business management of his company and the various technical and educational organizations. It is up to the forester to keep in touch with the developments in his profession through his connection with such societies as this and by cooperation with the governmental agencies. There is a very real danger of the younger foresters becoming so immersed in the fascinating practical details of their logging operations that they forget they are foresters. In the earlier years of our technical societies, 10 and 15 years ago, many men were lost to their profession through failure to keep up this contact. These men, although holding degrees in Forestry, are valuable additions to the business world, but are no more foresters than if they had been graduated from schools of law or medicine.

I hope I have given you some idea of how the Pejepscot Paper Company is making use of its foresters and of our methods of management. I have not attempted to classify our methods of cutting in accordance with European terminology. We do not use those terms in our own work and I would have to dig into reference books to tell you which of the great European foresters we are following, if any. Our primary efforts have been to protect our forests and to eliminate waste in our logging operations. Our next efforts have been to keep our forests growing as rapidly as possible. Within the next decade or two I hope we shall progress a little further in efficiency. There is so much to be done and at the same time so much need for economy that it has been necessary to make blanket decisions and blanket regulations covering large areas and somewhat diverse conditions. I feel like making some predictions of what the next moves will be in improving our methods of management. I think that the next steps will be the marking of trees to be cut or perhaps a diameter limit with marking of trees to be left, deadening of worthless hardwoods, weeding in dense softwood thickets. This may be followed later by marking felled trees before they are cut into logs in order to avoid the waste resulting from poorly cut logs. These and other similar developments I feel that we should prepare for and work toward.

FIRST STEPS IN FOREST MANAGEMENT.*

By J. D. Gilmore

Director Anglo-Newfoundland Development Co.

The expression "Forest Management" as used in this paper, means the scientific handling of forest lands so that they will produce timber in perpetuity, and more than that, so that timber thus produced will be commercially the most profitable. The best forest management is that system which will keep the forest productive and which will at the same time produce for each dollar expended the largest quantity of the required class of timber.

This paper is written primarily from the standpoint of the manufacturers of pulp and paper. If the practice of scientific forestry can be instituted by any private interests in Canada as a measure which is commercially sound, surely it is by the pulp and paper companies, with their huge investments, fixed and costly plants, and with markets for their products which considered over a term of years, show continuous expansion.

There is invested in Canada in pulp and paper manufacture approximately half a billion dollars, and this investment is continually being increased. The bulk of this investment rests for its ultimate security almost entirely on the timber lands tributary to the mills.

It is unquestionable that by the application of sound forestry methods this security can be maintained indefinitely, or at any rate for a very long period. It is equally true that a considerable portion of this investment will have to be written off within a generation if destructive and wasteful logging methods, recurring fires, and neglect of cut-over areas are continued as at present in the majority of timber holdings.

Those who established the Canadian pulp and paper industry and who speedily brought it to its present large production, were men of courage endowed with foresight and vision. It is only what we would expect to find in these days if the proprietors and managers of most pulp and paper companies see with increasing clarity that their timber holdings are vital to them. Many already employ foresters to advise in the management of their timberlands.

*Presented at the Seventeenth Annual Meeting of the Canadian Society of Forest Engineers.

We, as foresters, believe that an operating pulp and paper company can profitably invest money in the application of forestry methods, in fact, that they must do so. The managers of pulp and paper companies to an increasing extent agree with us. It is the business of the forester employed by such a company to indicate in what manner and to what amount such investment can most profitably be made.

A forester who is placed in charge of the timber lands of an operating pulp or paper company has been entrusted with the management of their most valuable asset. At the outset he requires to make himself familiar with their timber holdings, and must gather certain data which will enable him to determine on a silvicultural policy. His preliminary work may be summarized as follows:

1. Stock-taking to determine the present position.
2. Studies to determine what is taking place now in the areas of virgin timber-lands.
3. Studies to determine what is taking place on lands which have been logged off or have been burned over.
4. After spending sufficient time in field and office to get well started on the foregoing three classes of work, certain silvicultural measures will have presented themselves as being apparently practicable. His next task is to concentrate on a further study to ascertain for certain the results of the measures he has in mind. He can do this in two ways:

   (a) A large forest property presents examples of every condition; suitable areas which have a bearing on the particular point he wishes to study can be found, and close examination of all such areas may save several years' time which otherwise would necessarily be taken up with experimental plots.

   (b) Establishment of sample plots where on a small scale and at the least expense any proposed method may be tried under conditions where exact data may be obtained.

The above four headings comprise in simple language all the steps which are required for the formulation of a plan of management, or working plan.

The peculiar conditions incident to the operations of the company by whom he is employed have a bearing on the intensity of the investigations the forester is warranted in making. For example, where its timber holdings are plainly ample for present or immediate future developments of the company, less careful stock-taking is required, there-

fore less money should be spent on it. The same is true in regions where stumpage values are low.

In all his work it is most important that the forester retain a proper sense of perspective. In the remote and largely undeveloped regions where most pulpwood holdings are now located, the present generation of foresters should not aim at the hasty introduction of methods which exist where scientific forestry has been practiced for perhaps centuries, where there is a large and stable population, and good permanent means of transport. The forester should try to visualize his employers' operations as a whole and especially bear in mind the area of the best timber-lands which is every year being logged off. If after-conditions on these logged areas are unsatisfactory, and this is almost certainly the condition he will find existing, it is manifestly his first duty to seek means which will ameliorate the destruction caused by logging. If some rough-and-ready method can be found which, without unduly increasing the cost of producing pulpwood, will improve the next crop, this appears to be the first step in management. If a company annually logs off 10, 20 or 50 square miles of its best timber-lands, a slight increase per acre in quality or quantity of the next crop will amount to large totals in a generation, or during the period the company first logs off all the virgin timber.

Neglect of logged-off lands will take a long time to show up in the operations of any company, but must eventually do so. When the results of such neglect finally appear it may readily be too late to do anything; the lands will, in many cases, be in such condition that their reforestation would be so costly as to be commercially impracticable. In addition, timber production on these lands which might, under proper conditions, have taken place has been lost. It appears to the writer that the forester in charge is guilty of gross neglect of his duty if logged-off lands are allowed to become permanently unproductive wastes without a serious attempt to prevent such a condition arising.

The intensive management of small areas, while at the same time large and rapidly increasing areas of potentially productive lands are left to chance, does not seem to be good forestry, and is therefore not good business. Is it not most likely that this generation of foresters should direct their efforts to the study of wholesale methods, cheaply applicable over large areas? It is not disputed that the concentration of forestry expenditure on small areas will give good returns. Foresters should not, however, lose sight of the probability that better returns are obtainable by the expenditure of effort on large-scale but grad-

ual improvement of all logged areas. There is no doubt as to which course will show the best average forests to the forester who has to handle these pulpwood lands in 1950 or in 1975.

These considerations explain the use of the word "perspective"—the forester's understanding of his place in the industry, and of the present-day standard of forestry which is commercially attainable by his company under modern conditions.

The writer would like now to present a brief report on forestry work done in Newfoundland to illustrate how an attempt is being made to apply rudimentary principles of forestry. We do not wish to give the impression that as yet a full-fledged system of management for sustained yield has been instituted; or that we are already following an elaborate working plan. If we are in a rough way doing so, it has not yet been definitely put on paper. We are, however, able to report that some advances have been made towards an understanding of the forestry problems which confront us, and that further progress is being made. The course we are following may be applicable to the northern and northeastern pulpwood regions of Canada, where forest conditions are somewhat similar. It is founded on the results obtained during stock-taking, supplemented by various studies of growth and reproduction.

Wherever spruce and balsam fir occur in commercial quantities in Newfoundland they are the permanent and dominant species. There is no jack pine in Newfoundland. Neither are there any shade-enduring hardwoods, but only white birch and a little poplar. We are not faced with the problem which confronts the forester handling lands in central Canada along the southern edge of the pulpwood region, namely, the persistent tendency of shade-enduring species of hardwoods to fill up the forest whenever the pulpwood is logged.

In the Newfoundand type of forests there are other problems, the chief of which is the tendency of the inferior balsam fir to increase on cut-over lands at the expense of spruce.

A considerable tendency to wind-damage prevails, so that diameter-limit regulations would be useless. From the standpoint of the logger it is a good thing that this is true, and probably also from a forestry standpoint it is not undesirable. Doubtless the application of diameter-limit regulations to types and species which it suits is very satisfactory, for example, to the yellow pine and larch stands found in the western inter-mountain regions. It is very doubtful whether it should be applied to the sparse and shallow-rooted forests found in the Northeast;

certainly its blind application to all types found in the Northeast is the most useless, expensive and destructive of stumpage of all the forestry measures anywhere employed.

The Anglo-Newfoundland Development Co., Ltd., and other companies associated with it, hold timber licenses amounting to 6,348 square miles in Newfoundland.

This area has all been mapped and more or less accurately cruised, most attention having been given to the best areas, and those which from their location, age and quality will be utilized first. This cruise is probably between 75 and 90 per cent of the actual quantity; no greater accuracy is claimed for it, or is in our opinion warranted at this time.

The location, area and age of the principal old burns on the property are known, also the fact that these constitute from a long-range viewpoint the most valuable lands held by the company.

Careful studies have been made of the reproduction on logged-off lands, of wind-damage and enhanced growth, if any, among trees left behind in logging.

One of the first things noted by a forester in Newfoundland is the heavy coniferous growth on all old cuttings, and the high percentage of balsam fir contained in the new growth after cuttings. Studies made on many sample plots on lands which had been logged for ten years confirmed the first impression, namely, that where land is logged clean and protected from fire the new stand is largely balsam fir. On the balsam spruce-hardwood type the following facts were found:

By a count of stumps it was found that the original pulpwood stand was 75 per cent balsam, that is, by number of trees, not by volume.

The new stand was made up as follows:

NUMBER OF TREES PER ACRE

Species	Balsam	White Spruce	Black Spruce	Birch	Total
Seedlings	8062	32	137	365	8596
Saplings	1735	53	43	69	1900
Total	9797	85	180	434	10496
Per cent	93	1	2	4	100

This shows a fully-stocked stand, where the dominant balsam fir, with a few spruce, may eventually make good progress. It is true that balsam fir will be considered a valuable pulpwood tree in another 50 years; but it would be advantageous if without much extra cost a higher percentage of spruce could be obtained. This stand is so very

heavily stocked that the result is doubtful; there is a tendency towards the production of fir-thickets rather than pulpwood sizes.

There is the further serious risk where the new stand is nearly pure, and that is, insect damage is more likely, and if it takes place will be more disastrous.

Considering this problem further it appeared to us that there was very grave doubt whether all the logged-off areas could be permanently protected from fire if these areas were left covered with heavy slash for years after logging. Such lands might be successfully protected for years, but the logged area was growing every year, and it appeared more than likely that fire would at some time get out of control and sweep over large areas. The result, if such a fire occurred several years after logging, would be the total destruction of coniferous trees, no seed-trees left, nor any seed in the ground, with final abandonment to birch and poplar, redeemable only by planting.

Attention was next turned to existing stands which are the result of old fires. As previously stated, such areas comprise some of the most valuable long-term holdings under license by the company. Some are 60 years old, some 30, some 20. All these old burns are covered with better stands than the old areas of virgin timber, where there has been no fire for a very long time. There is a higher percentage of spruce on these burns, and a better rate of growth.

A few miles from the area where the reproduction studies reported in the foregoing were made, on the same side of the same lake, there was a burned area 14 years old. Presumably, and from all accounts, the stand before the fire consisted of a similar mixture of balsam spruce and hardwood, with scattered white pine. The soil and exposure conditions are identical on this burned area, and on the other area which was logged, protected from fire afterwards, and now bears a nearly pure stand of balsam fir.

STAND PER ACRE ON BURNED LAND—14 YEARS AFTER THE FIRE

Species	Balsam	White Spruce	Black Spruce	Birch	Aspen	Larch	WP.	Total
Seedlings	10	1	331	61	104	199	3	709
Saplings	6		180	371	234	124		915
Totals	16	1	511	432	338	323	3	1624
Per cent	1		32	26	21	20		100

As the black spruce saplings were already producing seed quite plentifully, it appears that such a stand will produce finally a very sat-

isfactory stand of spruce. Judging from burns of all ages which were studied, the hardwoods will largely decrease in numbers as the stand grows older. The number of larch is remarkably high on these burns during the first two or three decades, being much more plentiful than is ever found in the old forest. Their number grows less as time goes on, and being light-demanding they do not retard black spruce to any extent.

The burn which shows the above results took place before the present company started operations in Newfoundland, and before logging except for an occasional white pine. The fire was a severe one, occurred in early summer, was a ground and crown-fire, and exposed the mineral soil over most of the area. It was a much more severe fire than anyone would voluntarily use in slash-burning. Better results can readily be found where the burn was less severe; but even on this burn the result is better than where lands are logged clean and fires carefully kept out.

A further study of these burns, with particulars as to the season in which they took place, and the severity of burning, convinced us that our balsam-spruce stands are analogous to the hemlock-Douglas fir stands found on the Pacific Coast. When these latter stands are logged, and protected from fire, the result is a full stand of hemlock, and the exclusion of the more valuable Douglas fir. If they are properly burned over immediately after logging, the result is a stand of Douglas fir. Exactly the same thing happens in the balsam-spruce type in Newfoundland; protect the cuttings and you get balsam, clear up the slash by light burning at the proper season and you get spruce. At the same time, the fire-danger is greatly reduced during the seasons when fires must be kept down, both the logged-off lands and adjacent timber being protected from destructive and uncontrollable fires.

The success of this method of slash-disposal depends on the assumption that there is always under the forest plenty of viable seed in the ground. In order to be successful it is necessary to dispose of the slash as soon as possible after logging, preferably in the first season. If slash-disposal is postponed much longer than this, it is too late, all the seed which was in the ground has already either germinated or died, and no coniferous species can be expected. The only course then is to protect such areas against fire altogether.

Disposal of logging slash by controlled broadcast burning has been under observation now for four seasons, and in the fall of 1924 the first definite results were observed, namely, a good stand of spruce seed-

lings, among which no balsam could be found, on an area logged in 1920-1921, and burned in 1921.

To date, although several square miles of slash have thus been purposely burned over, no attempt has been made to burn over all the logged-off land of the mixed type where we believe this method to be sound. The areas burned so far, consist of strips and patches along roads, around camps and areas where the original stand was extra heavy, thus making it easy to get fire to run over it. Continuous areas of approximately one square mile have been burned on occasion at one time. Such are the largest continuous areas so far handled by us in this manner.

So far as we have gone it seems that controlled broadcast slash-burning is cheap and effective in our mixed stands of timber. If further observation proves this to be true, and the next stands come up to expectations, slash-burning will be extended to comprise each season most of the mixed stands which are logged. The question of fire-protection of standing timber will be greatly simplified, and the cost thereof reduced, as well as the risk of damage which is ever present no matter how efficient the fire-protection organization may be.

The best time to burn logging slash is in the fall. A certain amount of risk is inherent in the operation, but in the hands of a competent foreman this may be kept fairly small. In the long run the loss will be less than by the occasional big fire which will get away if the slash is not burned. By doing the work after the fall rains have started, there is no danger to standing timber; the risk is greater with respect to other property such as camps, stores or improvements. We have had no appreciable difficulty in this respect.

Another experiment we have in progress is being carried out on twenty-four sample plots, each comprising six acres. These were logged in 1920-1921. The plots were logged in various ways, some clear-cut, some cut to various diameter limits, some were logged in strips and groups, and on others spruce seed-trees were left. Slash was handled in three different ways—burned during winter logging, tops lopped, and on other plots left as usual. Careful costs were kept separately for the logging of each six-acre block.

An examination in the fall of 1924 disclosed certain features which are patent to preliminary observation; more detailed examinations will be made periodically.

Conclusions so far indicated are:

1. Winter burning of slash during logging of pulpwood is disproportionately expensive considering the small benefits derived. The cost of winter burning is in our experience about 20 times as great as burning the slash in the following fall, and the benefits are less. Winter burning reduced the fire-risk to some extent, but not nearly as much as fall-burning. It has no effect on the composition of the next stand; whereas we are practically certain that fall burning has a marked beneficial effect.

It seems to us that winter-burning of slash may be placed in the same category as diameter-limits in general; each method is suited to certain types and species, but neither seems to be suited at all to Eastern pulpwood types.

2. Reproduction is equally good, and is of the same species, on the blocks where the brush was left, where it was lopped, and where it was burned during logging. The same is true of the strip and group cuttings, and the plots on which spruce seed-trees were left. In every case the same thick stand of balsam fir seedlings, with a few scattered spruce, amounting in all to approximately 10,000 trees per acre, is found.

About one-half of the seed-trees are already blown down, and there is heavy windfall loss on plots which were logged to a diameter limit. This loss still continues in every heavy storm.

The results from these sample plots have therefore been only negative so far, and clearly show several methods which are not sound forestry. It is extremely valuable to know the actual results of all likely theories when applied to stands with which one is dealing.

These first steps towards forest management illustrate the attempt we are making to take advantage of the natural forest conditions which have been encountered, so that in a practical manner without the expenditure of much money the general conditions of the forest may be improved. A sustained effort is being made gradually to apply methods to logged-off lands which will produce a second crop of reasonably good quantity and quality. It is not wise to make undue haste, but it is important to keep very clearly in mind the ultimate object—namely, the control of cutting and the introduction of methods which will maintain and improve the company's forest assets, at the lowest cost in proportion to the results which are anticipated.

FORESTRY AS PRACTICED BY A CORPORATION*

By Le Roy Frontz

Corporations like governments are long-lived organizations. With a large land area and resources a corporation is in a position to practice forestry that is second only to that occupied by a government. They, too, like governments must anticipate their needs many years in the future and lay their plans accordingly.

Since I happen to represent a corporation that is endeavoring to practice forestry and also make it pay its own way as far as possible, I thought it might be of interest to tell of the forest product needs of such a corporation and of the work that is being done to meet these same needs; future as well as present.

We have found from our records and by careful checking that to mine one ton of coal two prop and two board feet of lumber are consumed. A prop foot is equivalent to a piece of lumber 4″x4″x12″. The two board feet used per ton includes cross ties for tracks, roof support, drift timber, mine car lumber, tipple timber and repairs. The average daily tonnage of the mines when running is 5,000 tons. Thus our daily consumption of lumber is 10,000 prop and 10,000 board feet. The mines run on an average of 250 days per year, using a total of 2,500,000 prop and 2,500,000 board feet, or changing prop feet to board feet, we have a total of 5,500,000 board feet of lumber consumed each year. In addition, during the last four years 2,000,000 board feet of lumber has been used in the construction of new houses for the miners.

With from 1 to 300 years of coal mining ahead at present rate of production, the question now arises as to where can this very necessary supply of forest products or timber to run the mines be procured. This question began to bother our officials a few years ago, due to the increasing difficulty in securing the sizes and kinds of lumber needed and to the very fast increasing or mounting prices. The reason for this increasing scarcity and mounting prices of lumber of all kinds is, of course, due to the exhaustion or near exhaustion of our local supply of timber.

In the face of this situation and as an answer to the question as to where this very necessary supply of timber for running the mines can be gotten, the Forest Department of the Clearfield Bituminous

*Read before the Allegheny Section, Harrisburg, Pa., March 7, 1925.

Coal Corporation came into being. We expect to *grow our own*. The corporation owns the surface rights to about 26,000 acres of land suited principally for the growing of trees. With this acreage to work on three forests were established as follows:

NAME	ACREAGE	COUNTY
Peale	15,000	Centre and Clearfield
Bigler	1,700	Clearfield
Patton	4,500	Cambria
Total	21,200	

Each of these forests is in charge of a regularly employed warden or ranger; woods workers and other help being employed as the occasion demands. The balance of the acreage is scattered in small tracts near the corporation's mines.

This area is estimated to be divided up about as follows: 2,000 acres of virgin or merchantable timber; 20,000 acres of young stuff from one to fifty years of age about one-third of which is stocked, the remainder will require filling in by planting; 4,000 acres of barren, or nearly so, due to repeated burnings, which will have to be reforested by planting.

These lands will grow on an average of a cord of wood per acre per year, or about 500 to 550 board feet. Our present land area, after the barrens have been planted, will produce each year about 15 million board feet or about twice the amount of lumber the mines are now using.

The first thing necessary to the practice of forestry is fire protection. As a well known forester has said "without fire protection forestry is impracticable if not impossible." One of the first acts of the forester was to make these lands as nearly fire proof as possible. This fire proofing has been accomplished by developing a system of fire trails and roads over the forest areas so to make them accessible and by employing patrolmen and look-out men during the dry, or danger season. A fire tower has been erected and is connected by telephone with the State Tower. The roads and trails have been layed out so that they can be used in logging the areas which they cover. It is noteworthy that since the construction of one of these trails in the Peale Forest above the New York Central tracks of the Beech Creek Division that no fires have run over this

area which previous to the time of doing this work was burnt every year and sometimes twice in the same year. During 1924 two fires occurred on corporation land burning an area of sixty acres.

The lumbering that is now being done consists of removing fired scarred, dead, or dying and down timber. Sound trees of valuable species are left as seed trees. Care is used in logging to protect and to save from injury as far as possible the young trees of all valuable species.

After the logs are removed from the woods and to the landing, they are loaded on flat cars and shipped over the New York Central lines to our mill at Clymer. This is electrically equipped, uses a 60 inch circular saw and is a 20,000 board foot capacity mill; the power being generated at the Corporation Central Plant a scant mile away. The by-products from the sawing as mine caps, plastering lath and fire wood pays all mill labor. One of the big advantages of having the mill located close to the mines is that any kind or size of timber can be supplied on short notice.

In connection with the sawmill and lumber yard the planing mill is operated.

An open tank treating plant has been recently added to our equipment. Ties, lagging planks drift timber and structural timber are now being treated before being sent to the mines.

In marketing our timber we charge the collieries a price that is slightly lower than the same material can be bought in the outside market. We bear all costs of logging, haulage and manufacture. The Land Department is credited with the stumpage and also charged with the planting costs.

During the past three years the Department has manufactured all the lumber necessary for structural and repair work in and about the mines. With the exceptions of flooring, doors and window sash, it has manufactured all the lumber used in the construction of 166 miners' houses.

With our present stock we estimate that 20,000 acres of the lands are now growing at the rate of 150 board feet per acre per year, or a total of 3 million board feet. We expect to cut considerable less than the annual growth for some years to come as the present stands represent a heavy preponderance of the youthful age classes.

Since the establishment of the Forest Department four years ago, 431,000 seedlings supplied by the State have been planted.

White, Norway, Scotch and pitch pine, Norway spruce and larch have been the principal species used. Unfortunately, however, the Department has been unable to furnish more than 50 per cent of the annual requirements and in order to give us sufficient supply of young trees for our purposed planting or reforestation work each year a nursery was started at Clymer, Pennsylvania, in the fall of 1923. The nursery has an area of five acres, three acres of which are under irrigation. A nursery building, combining a packing shed, storage cellar and work shop has been built. At the end of the first growing season the inventory showed something over 2 million one-year seedlings in the nursery, the principal species being white and Scotch pine, Norway and white spruce and larch.

Present planting plans call for the planting of from one-half to a million trees per year, an increase to one-half to two million is contemplated in the future.

This corporation's work is unique in that it is both a grower and consumer of wood. Seedlings grown in our own nursery are transplanted to the fields and woods, protected from fire, timber is cut under a sustained yield basis, and the product delivered to the mines, making a lumber service to the mines that results in a reduction in the cost of mining coal.

CHARACTER OF THE SOIL IN RELATION TO THE REPRODUCTION OF WESTERN YELLOW PINE

By Frederick S. Baker

U. S. Forest Service

The opinion is very frequently expressed by foresters throughout the West that Western yellow pine reproduces best in sandy soil. In some places where growing conditions are first class, reproduction may be found upon heavy, clayey soils it is true, but in general it has been noted that where conditions are rather difficult for reproduction, a sandy soil is evidently much superior to a heavy clay soil. No investigations have yet shown exactly why this is so, or indeed whether it is actually a fact connected with the soil at all. There is a constantly increasing mass of information, however, regarding the factors which influence the reproduction of Western yellow pine, and in order to add a little evidence to this body of information, the results of an experiment carried out some years ago at the Great Basin Experiment Station in Utah, are presented herewith.

The conduct of this experiment was far from ideal and a number of loopholes were left. The basis for the results is rather small, and so it is hardly correct to say that this experiment proves anything, although the results strongly indicate that the opinion that light soils are favorable to Western yellow pine is correct, and that this effect is due not entirely to the different water relations existing in heavy and light soils, but is connected in some way with the texture of the soil per se. The experiment was originally planned to determine whether or not an acid soil was favorable to Western yellow pine. This hypothesis was presented by Dr. A. W. Sampson[1] following certain work in the Wallowa Forest in Oregon.

A series of six different kinds of soil of varying degrees of acidity and alkalinity were secured and Western yellow pine seed was planted in each.

The first was a lodgepole pine soil secured from near Big Springs, Idaho. This soil was derived from the basaltic rock of the Yellowstone Plateau and was decidedly acid, requiring 2,632 pounds of lime per acre foot for neutralization. It showed little humus color, and may be classed as a very fine sandy loam, composed of volcanic ash, very fine sand and silt.

[1]Sampson, A. W. The Relation of Soil Fertility to Plant Societies. Proc. Soc. American Foresters, Vol. 7, pp. 51-57.

The second was called "manzanita" soil, as it was obtained from the manzanita brush (*Arctostaphyllos pungens*) type in Ephraim Canyon. This soil was derived from a reddish brown sandstone rock, which was found outcropping in many places near where the soil samples were secured. This soil was taken from the top six inches only and contained some organic matter and leaf debris. It was a very fine sandy loam and was slightly acid, requiring 610 pounds of lime per acre foot for neutralization.

The third soil was named "white fir" soil, as it was found in a white fir (*Abies concolor*) type not far from the place where the previous sample was secured. It was a very fine light colored, sandy loam, neutral in reaction, having little humus or color from organic matter.

The fourth soil was a loamy fine sand from the natural Western yellow pine type as found in the southeastern portion of the Manti National Forest in the area known as "The Pines" near the head of Link Canyon. This soil was very slightly alkaline.

The fifth soil, named "aspen" soil from the fact that it was secured from the upper four inches of soil in the aspen type near the Great Basin Experiment Station, was a mixture of aspen leaf mould with a little clay sub-soil. It was alkaline in reaction and very porous and rich.

The sixth soil was a clay of geological formation very highly calcareous, and decidedly alkaline in reaction. It was secured in a swamp near the Experiment Station nursery. The character and physical properties of the soil under consideration as used in this study are given in the following table:

TABLE I.

THE SOILS

Source or Name	Acidity. Lime Req. Lbs. Per A. ft.	Wilting Coefficient	Saturation	Organic Matter Per Cent
Lodgepole	2,632	7.3	32.8	4.7
Manzanita	610	11.4	52.2	6.6
White fir	Neutral	5.6	25.5	3.9
Pines	Slightly Alkaline	3.3	27.4	6.5
Aspen	Alkaline	25.0	100.2	27.6
Clay	Very Alkaline	14.1	61.2	8.2

At the time this work was started (1914) the present day methods of determining soil acidity were not developed and in the case of these

soils, the determination of acidity was made by the lime-water method, in which a number of small samples of soil are treated with lime water, increasing the amount step by step with successive samples until by repeated trial neutralization is found, using phenolphthalein as an indicator. The degree of alkalinity was simply expressed by the depth of color secured on treatment phenolphthalein. The wilting coefficient was determined by the indirect method of Briggs and Shantz, in the Biophysical Laboratory, Bureau of Plant Industry. The content of organic matter was determined by incineration and subsequent treatment to carbonic acid in the case of the soils which contained lime, in order to replace whatever carbon dioxide might have been lost in heating. These six soils were placed in boxes approximately 15 inches square and 18 inches deep, and in each of them were planted 50 seeds each of Western yellow pine and Douglas fir and 75 of Engelmann pine seed.

The most uncertain factor of these tests was the water content of the soils. As already shown in Table I, they had different wilting coefficients and different saturation points. During the summer the soil boxes were watered with a sprinkling can, equal amounts of water being applied to each box irrespective of the character of soil. Obviously, in some of them the water content was much nearer the saturation point than in others. The "loam" soil and "peat" soil were both very absorbent soil, of course, the "peat" soil was easily saturated. The clay soil, on the other hand, absorbed the water with difficulty and considerable amounts tended to run down between the soil and the containing box, leaking out at the bottom. Nevertheless, it was evident that all the soils were moist and in a condition favorable for plant growth all the time.

Germination took place first in the "loam" soil and in the "peat" soil, being last in the clay. The rate of germination appears to be partly, at least, determined by surface temperature. Up to 9.30 P. M. on June 22, 1911, at the time when germination was going on rapidly, the following temperatures were observed in the soil at a depth of one-fourth inch:

Peat	71.5 degrees	Muskeg	68 degrees
Loblolly	71.0 degrees	Loam	68 degrees
White fir	68.0 degrees	Clay	62 degrees

At the end of the first year when the growing season was finished a count was made of all seedlings alive in each of these soils with special attention to the Western yellow pine. The results are shown in the following table:

TABLE II.

SEEDLINGS ALIVE AT END OF FIRST SEASON—OCTOBER 20, 1916

Soil	Western Yellow Pine
Pines	36
Aspen	26
Clay	38
Lodgepole	40
Manzanita	33
White fir	14

It is evident from this table that the survival of the Western yellow pine seedlings was not determined by the degree of acidity, for the maximum was shown upon the pines soil which was slightly alkaline, while the manzanita which was slightly acid had next to the lowest number living. With the exception of the case of the aspen soil, the degree of success agrees very much better with the wilting coefficient of the different soils, the clay, with its high wilting coefficient, showing a very low per cent of survival, while the pines soil tops the list. It is true that the aspen soil with its very high wilting coefficient shows good success, but the extremely high content of organic matter renders it physically very dissimilar to the rest of the set of soils. The behavior of these soils immediately suggests that where the wilting coefficient is very high on account of a large admixture of humus, as is the case of the aspen soil, a favorable soil is indicated, whereas where the wilting coefficient is high because the soil is heavy and clayey the effect is disastrous to the Western yellow pine seedlings. The results indicate that the success of first year Western yellow pine seedlings is largely dependent upon what is called in general the lightness of the soil. If a soil is porous and light whether on account of its content of sand, gravel, or other coarser material, or whether it is light on account of its high content of organic matter the result is about the same, although this lightness can not be readily expressed in a concrete way. Acidity is clearly not a limiting factor.

No further information was gained by following the results throughout the second year, because during the winter death occurred in the various soils in a hit or miss way, apparently due to the way the snow lay upon the boxes. They were so located that a very large drift covered a portion of them and the snow lay upon some of them very

much longer than upon the rest, a fact which apparently accounted for a large part of the difference in winter death.

The foregoing facts have dealt merely with survival of the seedlings. Their size was also studied and was found to vary independently of texture and soil acidity, apparently being governed chiefly by the richness and fertility of the soil, as the weight of the seedlings varied in about the same way as the per cent of organic matter in the soils, although the unfavorable effect of a heavy clay texture overshadows the effect of the organic content of that soil.

TABLE III

Soil	Organic Matter Per cent	Weight of Seedlings gm.
White fir	3.9	.145
Lodgepole	4.7	.146
Pines	6.5	.146
Manzanita	6.6	.155
Clay	8.2	.106
Aspen	27.6	.275

It has already been admitted that the data presented herewith are insufficient to base very definite conclusions upon, but the experiment, accepting it as it is, shows that the development of Western yellow pine is conditioned more by the physical character (lightness) of the soil under consideration than any other factor in usual forest soils, and that acidity is not a limiting factor. Of course, when alkalinity, or possibly acidity, rises to extreme points, these factors may have considerable bearing upon the growth of seedlings. While lightness of soil tends to favor the establishment of the young seedlings, their subsequent growth, except on very heavy clays and other unfavorable soils, seems to be determined by the degree of fertility (organic content) of the soil.

FOREST NURSERY WORKING PRACTICE AT SAVENAC NURSERY[1]

By G. Willard Jones, *Forest Examiner*

In order that those present who have not had an opportunity to visit Savenac Nursery may have a better knowledge or background of the institution, I want to mention briefly here a few points regarding its location, its size, and capacity.

Savenac is located in the western end of the Lolo National Forest in the Bitterroot range of mountains and has an elevation of 3,150 feet. There are under cultivation approximately 30 acres, eight acres of which are devoted to raising seedling stock and the remainder to raising transplant stock. Its authorized output is 3,000,000 trees annually, divided between the three most important Western species, as follows:

Two million western white pine.

Six hundred thousand western yellow pine.

Four hundred thousand Engelmann spruce.

Of these amounts approximately 50 per cent each are shipped from the nursery as two-year and three-year-old seedlings and the remaining 50 per cent as three and four-year-old transplants. A few thousand each of Douglas fir, western red cedar, and western larch are raised in order that we may keep in touch with the respective characteristics of each so as to know the best practice for handling them when the time comes that they are included in the capacity schedule in larger numbers.

SEEDLING CULTURE

Seedlings, or seedling stock, as referred to through this paper, have reference to that class of stock which is shipped directly from the seed bed to the planting camp, and transplant stock is that class of stock which is started in the seed bed and later transplanted in the nursery where it is cultured for two or three years more and then shipped to the field.

The object of raising seedling stock is that this class of stock can be produced more cheaply than transplants. The savings made are the transplanting cost, the cost of culturing for two years, and the carrying charge, or overhead cost, for at least one year; the total of which amounts to approximately $2.75 per 1,000. The cost of production,

[1] Paper read before Northern Rocky Mountain Section, Society of American Foresters, March 2, 1925.

however, is not the principal factor. The quality of stock is what is desired. Because it is difficult to raise seedling stock which is hardy enough to survive on severe sites, it is therefore necessary to raise some transplant stock. The western white pine and western yellow pine have a tendency to develop a long taproot and long laterals with few sub-laterals. This condition is more pronounced in overcrowded beds so that, in order to get a well-balanced tree, the long taproot and long laterals are pruned, thus permitting the development of more short laterals and root hairs, the object being to produce a better balance between the absorbing and transpiring surfaces.

Both classes of stock are started in seed beds and the practices are virtually the same for the first and second years with two exceptions, namely: the stock to be transplanted is grown about twice as densely as seedling stock; and yellow pine seedling stock is not fertilized.

PREPARATION OF THE SEED BEDS

The ground is prepared by the customary methods used in preparing any garden. It is first plowed to a depth of 10 to 12 inches, then disked and harrowed to pulverize the lumps and to level the surface. If these operations are not sufficient, further pulverizing and leveling is done with a float. When a commercial fertilizer is used, it is spread after plowing and disked into the soil. After the area to be sown has been floated, it is laid out in rectangular units with two-foot paths between. The units vary in size from one to six 4x12 foot beds. Stakes about 14 inches long are driven on the four corners of all units and heavy twine is stretched to define the sides and ends of the beds. The whole area is laid out at one time, insuring a more uniform and systematic operation. This adds materially to the appearance of the area after it is sown. The beds are then further leveled with hand rakes and a wooden straight-edge about 18 inches long. At this operation, all stones, roots and weeds are picked off and removed from the area. Walking and wheeling of heavy loads of rock and sand in the paths lower them sufficiently and therefore no attempt is made to raise or curb the beds.

FERTILIZERS

The practice of fertilizing undoubtedly is the foremost practice in nursery work as the quality of stock and the length of life of the nursery depend upon the fertility of the soil. The fertilizers heretofore used have been limited principally to concentrated commercial fertilizers and soiling crops. Barn manures have not been used very exten-

sively for two reasons: first, they carry an abundant amount of weed seed which increases the weeding problem with each application; second, the supply of this fertilizer is very limited in the vicinity of Savenac and the real value of such a fertilizer as compared to the cost of shipping it in does not justify its use. The commercial fertilizer, blood meal, is used for correcting the deficiency in nitrogen and bone meal for the deficiency of phosphoric acid in the soil. They are spread at the rate of two pounds of blood meal, and one pound of bone meal per 48 square feet. A soiling crop of peas or sweet clover is used for the purpose of building up the physical condition and also for its value in furnishing nitrogen by the growth of nitrogen nodules on the roots. Sodium nitrate has been used only in an experimental way the last year and no definite conclusions as to its value can yet be drawn. Also, hydrated lime has been spread at the rate of one and three-quarters tons per acre for correcting the acidity of the soil. Its application was made only this last fall and its value will not be determined until after one growing season.

SEASON TO SOW

Another important element is the time for sowing each species. Studies have been made for all the major species and it has been determined that quite a difference may be expected in the germination if seed is not sown at the right time during the fall or spring season. A week's variation from the optimum time of sowing causes a heavy hold-over germination, particularly in the white pine. The same is true to a lesser degree of western yellow pine, but for the reason that we are rarely able to work the ground for sowing yellow pine until after the middle of April, we have about a 10 per cent hold-over and delay in germination in this species which is culled when the trees are lifted. Western white pine is sown the first week in September; western yellow pine as early in the spring as possible, and spruce the first week in May. About equally good results are obtained with fir and cedar when sown either in the spring or in the fall. If larch is soaked for five days before sowing in the spring, the results are about the same as if sown in the fall.

SOWING

The amount of seed to sow per bed is figured from the utilization value or real value of the seed per pound, plus a correcting factor of from 20 to 40 per cent to cover losses from the time of sowing to the time of shipping, and the desired density of stock per square foot. The

utilization value is determined by germination tests made previous to sowing and the density is determined by the species and the class of stock to be sown for. Only the amount of seed for one seed bed is weighed at a time. In this way a more uniform and accurate distribution of seed is made. All seed is sown broadcast.

DENSITY

The species and also the purpose for which the stock is grown, whether seedling or transplant stock, determine the density for sowing. For the reason that all species do not have the same characteristics, it is not desirable to sow for the same number of each per square foot. Western yellow pine is a much larger plant at one and two years than any of the other species at the same age; consequently, it is not practical to raise as many yellow pine per square foot as western white pine, spruce or fir. If the plants are to be transplanted at the age of one year, as in the case of yellow pine and white pine, or at two and three years in the case of fir, larch and spruce, they are grown approximately twice as thickly as the same species grown for seedling stock. Densities sown for, per 48 square feet, are as follows:

Yellow pine seedling stock	2,400
Yellow pine transplant stock	5,000
Western white pine seedling stock	4,500
Western white pine transplant stock	7,500
Engelmann spruce, Douglas fir or western larch seedling stock	3,750
Engelmann spruce, Douglas fir or western larch transplant stock	7,500

After the beds are sown they are rolled with a heavy water-weighted roller for the purpose of firming the ground well about the seeds. The roller is slightly wider than the bed and two feet in diameter. It is tapped at one end for the purpose of filling so that the weight can be easily regulated.

COVER

Following the rolling operation, the beds are covered with river sand or a mixture of river sand and dirt. The depth of cover being a very important factor entering into the success of germination and the uniformity of stand, it is very necessary to apply an accurate and uniform thickness, and only by the use of a mechanical spreader can such accuracy be obtained. The machine used at Savenac consists of a large hopper for carrying the sand, mounted on wheels, and an endless belt

which runs under the hopper and is driven by a gear fitted on one wheel. The amount of sand deposited upon the belt can be regulated by raising or lowering the hopper. It is very necessary that the sand be dry so that it will run freely. The depth of cover varies with each species.

Sand is preferred to dirt as it has a tendency to reduce damping-off and it does not become baked and thus interfere with the seedlings coming through the cover during germination. A mixture of sand and dirt has been tried and gives very satisfactory results.

WATERING

The method of irrigating the seed beds is by sprinkling. The water supply is brought along the hill-side above the seed beds in an open ditch and small reservoirs are placed at convenient points above individual areas. According to the size of the area to be served, the reservoirs are tapped with a three or six inch main, which extends through the block of beds. Laterals of smaller pipe branch off at path intersections so that all hose connections fall in the paths. The laterals are fitted with a faucet every 24 feet and from here lines of garden hose are run out with common lawn sprinklers attached. From 8 to 14 sprinklers operate at a time, each sprinkler covering a radius of more than two beds. The length of time they are let run in one place depends upon the dryness of the soil. It is customary to have them run until the ground is soaked to a depth of 8 to 12 inches. During the period of germination in new beds, sprinkling is light but frequent. For spruce it has been determined that heavy watering stimulates growth, consequently spruce is irrigated more than any of the other species. Specially designed sprinkling systems which do not require close attention are set up on the spruce areas and are left to run uninterrupted for half to three-quarters of an hour.

SHADING

The practice of shading is confined to spruce, fir, cedar and larch.

The shading is done with lath frames 4x12 feet. These are carried about 14 inches above the trees on stakes driven on the four corners. The frames are not fastened to the stakes, so that they are easily removed at the time of weeding. The density used is one-half shade.

Considerable care is necessary in removing the shade in the fall so that the plants will not suffer when it is taken away. The frames are removed during a spell of cloudy weather or are removed for an hour or two each morning until the plants become accustomed to the light.

WEEDING

The labor of weeding seed beds by hand has been reduced considerably in recent years by treating the beds with zinc sulphate. The salt is applied in solution at the rate of 13½ ounces dry weight per 48 square feet. The solution is mixed in a large wooden tank in sufficient quantities to treat 100 beds and is applied with sprinkling cans. It is necessary to use a container of a known capacity in order that the effectiveness of the treatment will not be lost by getting on too much or too little. The beds are treated as soon as possible after sowing so as to destroy all weed seeds before they have a chance to germinate. This treatment does not have any effect on weeds that have started to grow, regardless of their stage of development. The treatment is effective until the ground is disturbed by plowing the top soil. It does not have any ill effects on the tree seed nor on the soiling crops. As a matter of fact, it has a tendency to stimulate growth in the soiling crops.

MULCHING

Mulching is practiced with several of the shallower rooted species. One-year and two-year-old spruce and cedar are mulched, also one-year-old fir and larch. Rye straw is preferred to oat or wheat straw, since it has less chaff and it does not pack and heat. The mulch is spread quite thin—one bale weighing 60 pounds, will cover approximately 17 beds.

PROTECTING SEED BEDS

The most bothersome pests with which we have to contend in the nursery are birds and chipmunks and for the reason that all birds that bother are protected by law, we are obliged to employ other means than shooting or poisoning to keep them from getting the seeds, hence screen-covered frames 5 inches by 4 feet by 12 feet are used for this purpose. The size of the wire mesh is one-third inch and excludes not only the birds but also the rodents. The frames are laid on the ground and are banked with dirt. At a time when one compartment contains more beds than there are screen frames, a man is put on to protect the areas. A scarecrow will not do the work. It keeps an active man or boy busy throwing stones or beating upon cans to frighten the intruders.

TRANSPLANTS, PRACTICES AND TECHNIQUE

The purpose of transplanting, as has been mentioned before, is to give the nurseryman a chance to prune the roots of the plants and reset them at a wider spacing in order that they may develop better root

systems. Although transplanting is quite a shock to the young plant, if it is done at the proper time, and the plant is given extra care directly after being set, there is little chance of its dying.

PREPARATION OF GROUND AND SEASON FOR TRANSPLANTING

The ground is prepared in the same manner as for seed beds. However, it is done as far ahead of the transplanting operation as possible in order that the ground may have a chance to settle a little. All the transplanting at Savenac is done in the spring in order to avoid a heavy loss in frost-heaving, which is common among fall transplants.

CLASS OF STOCK

Of the three major species, white pine and yellow pine are transplanted at one year and shipped after two years in the transplant beds, and spruce is transplanted when two years or three years old, according to its size, and is shipped after two or three years in the transplant beds. Little transplanting has been done with fir and larch and cedar, so that the best practices for handling these species are yet undeveloped. However, judging from the fir which has been transplanted, it appears that possibly this species can be shipped after one year in the transplant beds. As for cedar, this species demands so much shade that transplanting is almost impossible.

The growing season is so short that with the exception of fir, stock cannot be developed in one year. The plant does little more than overcome the shock of transplanting and establish itself the first year. Ordinarily, in the second year, sufficient development is made to produce excellent shipping stock of most species.

METHODS

The open trench method is used in transplanting. This style of trench affords the planter a chance to see what he is doing when he sets his board and thus enables him to plant a tree better. It also eliminates four spaders on the crew which are necessary with Mast trenchers. The trench, or furrow, is made with a seven-inch plow equipped with an extension on the moldboard and a rolling coulter which runs along the point. The purpose of the rolling coulter is to cut a perpendicular side and of the extended moldboard to lay the loose dirt sufficiently far away from the trench so that it does not fall back into the furrow.

The beds are laid out the length of the field, or about 400 feet, with five rows to the bed spaced seven inches apart. A two-foot space is left between beds for a foot path and a ditch for irrigating. To start,

a line is laid the length of the field and two beds are worked at a time. A furrow on each side of the string is plowed, throwing the dirt out and away from the string. When the first rows are planted other furrows are plowed, alternating from one bed to the other, always throwing the loose dirt away from the trees.

EQUIPMENT

The board used in transplanting may, for many reasons, rightly be called a Forest Service transplant board, although it is patterned after the Yale board. Some of its particular features are: first, the pressure on the plant for holding it in the board is on the stem rather than on the crown; second, the wooden notches on the Yale board are replaced by a galvanized strip tapering to a narrow edge which allows the planter to tamp the earth closer against the stems; third, three automatic clamps keep the board closed, which makes for efficiency in opening and closing it, doing away with the old method of thumb screws; fourth, it is 8½ feet long rather than 8 feet long and holds 75 trees spaced 1⅓ inches apart; fifth, spikes about one foot in length are fastened to one side of the board, holding it in a vertical position while the planter rakes in the dirt. All of these features have been worked out by carefully following each movement connected with the work and in some instances by time studies.

The transplant table is also a Forest Service invention. It consists of a skeleton frame 3 feet 6 inches by 9 feet by 7 feet with two shelf-like tables spaced 14 inches apart, one above the other, and with racks at each end for holding seedling packets which contain a supply of seedlings to be transplanted. It is inclosed with canvas, which is light in weight, such a cover being absolutely necessary to protect the trees from drying and from being blown off the board while they are being threaded.

CREW ORGANIZATION

The plowman is also foreman and the number of tables or planting crews under him depends upon the length of the field being planted. The most efficient results are obtained if a planter does not have more than 10 boards per row. The planting crew is composed of two men, a threader and a planter. The threader works at the threading table placing the trees in the transplant board. The planter, as indicated by his title, does nothing but plant. He works with two boards, planting one while the other is being threaded. With 75 trees per board and an average of 35 boards per hour, one planting crew will transplant ap-

proximately 22,000 per day. At this rate of planting the average percentage of survival after five weeks is 92.5.

WEEDING AND CULTIVATING

All cultivating is done with a Planet Junior hand cultivator as the rows are too close together to permit a horse-drawn implement. The bulk of the weeds is kept down with this implement. However, it is necessary to remove by hand, the weeds which grow in the rows of trees, a tedious and expensive practice.

IRRIGATING

The transplant beds are irrigated through furrows. The supply of water is carried in flumes laid at the head of each compartment. These have small holes bored in them at the head of each furrow. Such systems allow perfect control of the water and enable the whole compartment to be irrigated at one time. The water is let run until the ground is thoroughly soaked. The heaviest irrigating is done during June, July and the first of August. It is reduced during the last week of August and the first of September in order to harden the stock for fall shipping.

SHIPPING METHODS

Seedling stock and transplant stock, when ready for shipping, are lifted with a digger which consists of a U-shaped blade mounted in a slanting position on an iron frame. The digger used in the seed beds is constructed of much heavier material than the one used for lifting transplant stock because of the heavier strain upon it when in operation. It is drawn lengthwise of the bed by means of a cable which is wound upon a capstan and operated by horse power. By such a method of lifting, the soil with the contained plants is elevated about six inches and as it drops over the rear of the digger the sheet of earth is broken up and leaves the trees in a loosened condition so that they are easily removed.

As the trees are lifted they are sorted and counted and tied in bundles of 100 and temporarily heeled-in. If they are not to be shipped for 12 hours or more they are placed in heel-in beds and sprinkled. From the heel-in beds they are baled in bundles of 2,500 to 5,000 according to the size of the stock. The baler in which they are packed is built on legs at a convenient height, is 15x18x25 inches with one side hinged for taking out the finished bale; and the baling frame consists of two cleats of wood 1x2x24 inches fastened with staples to two strands of

common baling wire. The wires are placed 13 inches apart with the cleats stapled 18 and 30 inches respectively from the loop ends. The packing device is on the principle of a winch. It consists of a crank 3 feet long made of iron pipe with holes bored in it through which the bale ties are passed. The handle end of this crank is loosely fastened to the baler which allows it to be brought on top of the bale when in use and to be out of the way when the baler is being filled.

Burlap and butcher's wrapping paper are used for holding the trees and packing material in place and also to retain the moisture in the bundle. The tops of the trees are turned out and the roots in, with water-soaked shingle-tow packed about the roots to keep them moist while in transit. With the trees packed and ready for shipping, the nursery loses the close guardianship of them that has been its part for so many years. Like orphan children the trees are sent out in the world to shift for themselves. They are not forgotten, however, for inspections are frequently made for the purpose of learning something from them in order that future trees and future generations may profit from the care that they have had.

AMERICAN FOREST TREES IN GERMANY

*German Dendrological Society**

Upwards of a hundred and fifty years ago the first attempts were made to introduce foreign, and particularly American forest trees into Germany. The degree of success obtained may be judged from the fact that in various parts of the country American trees of over 100 years of age are flourishing today. The first efforts were ably seconded by notable literary contributions to the subject, so that interest became widely spread. Pioneer work was done under the direction of various rulers of German federal states who introduced, planted and raised all kinds of foreign trees in their parks and forests. Specially to be noted are in Anhalt the parks and forest of Dessau, Wörlitz and Zerbst; Harbke in the Prussian province of Saxony near Helmstedt; in Hanover the famous park of Herrenhausen, adjacent to the city of Hanover; in Brandenburg the parks near Berlin and Potsdam; in Mecklenburg and Oldenburg, in Holstein and Thuringia in different parks and forests, and in South Germany, notably Darmstadt, Heidelberg, Schwetzingen, Karlsruhe. Silesia, Alsace and the Rhine districts have also a large number of foreign trees.

The efforts of the smaller rulers have not all been continued to the present, and the revolution which put an end to the various dynasties, in many cases also put an end to the benefits conferred upon the people by these beautiful parks which were almost always open to the public and generally maintained out of the private means of the princes. Nevertheless in most cases the new governments endeavor to continue the old traditions, and this is notably the case in Prussia, Anhalt and Brunswick and other states. The principal nurseries and dendrological academies continue to carry on the culture of foreign trees, raising them from the seed, etc. Here again, Brunswick (city), Chorin, Eberswalde, Tharandt, Münden, Aschaffenburg are to be noted. Very fine results have been achieved by the owners of large estates who vied with the princes in maintaining fine parks and forests. The late Prince Bismarck in Friedrichsruhe, Count Wilamowitz in Gadow (Brandenburg), Count Berckheim-Weinheim (Hessen) may be mentioned among these. The above remarks are intended to show how great the interest for foreign

*Unfortunately the name of the author of this article could not be located. Credit for this contribution will be given as soon as the identity of the author is established.—Editor.

dendrological specimens has been, and still is, in spite of the discouraging present conditions.

A very important factor in the observation of the degrees of success, attending the cultivation of exotic trees in Germany is the acquisition of reliable data, concerning climatic conditions and the behavior of foreign trees, when subjected to them. This subject has been worked out by Prof. Oscar Drude of Dresden and published by him in the Journal of the German Dendrological Society in 1900. According to Professor Drude Germany may be divided for this purpose into approximately eight climate zones, as follows:

I. Rhine Province (S. W.)

(S. W. Germany to Mosel valley, Achaffenburg in the Main valley and lower Neckar valley.) The least duration of frost is the rule here, the earliest spring and the highest average temperature.

II. Atlantic Province.

(N. W. Germany to Hamburg and western Holstein.) Later spring than in I., low average temperature, considerable rain fall.

III. Southern Province.

(Southern and central Germany from the Danube to Hessen-Darmstadt, southern part of Hanover, Thuringia, Elbe valley in Saxony.) Mean average duration of frost, mean commencement of spring, dry summers with a high average temperature.

IV. Central Province.

(From the Harz to the Oder and eastern Holstein.) Damper summers with lower average temperature than under III.

V. Eastern Province.

(Upper Silesia, Posen.) Frost continues into March and April, raw climate, cool summers.

VI. Baltic Province.

(Northeastern Germany from northeastern Pommerania across the Vistula to the former Russian frontier.) Longest duration of frost, commencement of spring later than the beginning of May, low average temperature, cool summers.

VII. Foothills in South and Central Germany.

(Rhön, Thuringian forest, Lower Erzgebirge, Swabian Alp., etc.) An even, continuous winter, snow lying for a long time, late spring, damp and cool summer corresponding in temperature about with Province IV and VI.

VIII. Mountains in South and Central Germany till the limit of regular grain cultivation.

(Certain parts of the Upper Harz till Upper Bavaria). The temperature is lower than in VI, because of the lack of summer warmth. Very long snow cover and very late spring.

Naturally the above described zonic conditions do not always maintain, and violent cold and frost periods and extreme heat often extend over the whole country, causing great damage.

Now remarks as to the general adaptability of American trees to Germany are in order, drawn from average observations.

Beginning with the *Coniferae* and among these with *Abies: Abies concolor* has in general produced favorable results, as it can stand great cold, is not sensitive to spring frosts and grows fast. Notably in northern Germany this species surpasses all other *Abies.*

A. nobilis, A. grandis, A. magnifica, A. amabilis which are also to be seen in various parts of Germany do well, but are of value chiefly for decorative purposes in parks, etc.

Of *Picea,* four species, chiefly, have been introduced and cultivated: *P. pungens, P. Engelmannii, P. alba.* and *P. sitchensis.* The latter flourishes notably in the North along the coasts of Schleswig-Holstein. It does well in damp, peaty soil and in sand, provided the latter be not too dry and thrives apparently, where no other conifer can get along. This tree is of lesser importance in South Germany, as it is there surpassed by the local *P. excelsa,* but in the North *P. excelsa* will not flourish, and thus a great future can be predicted for *P. sitchensis.*

P. pungens is valuable and promises good results under certain restricted conditions, notably when mixed in with other *Coniferae.* It is not touched by game.

P. Engelmannii is principally of value as a park tree, because of its great beauty.

Of *P. alba,* finally, nothing very particular is to be said. It, too, is a fine tree and to be seen flourshing in many parks.

We find several American *Pinus* varieties in Germany. *P. strobus* has been cultivated for so many years in certain sections, that it has practically become indigenous and is much valued for its excellent wood.

P. ponderosa does not thrive uniformly. It has been frequently planted in German forests, and although aesthetically of a certain value, economically it does not offer much encouragement. Climatic conditions

are against it, notably in the north. Both *P. strobus* and *P. ponderosa* are often much damaged by game and both grow slowly. *P. banksiana* has also been frequently planted, but satisfactory results have not been obtained. *P. rigida, P. murrayana,* etc., are found here and there, but present nothing noteworthy. They can only be cultivated under restricted conditions, or when mixed in with other varieties.

Of the widely introduced members of the *Cupresseae; Chamaecyparis lawsoniana, Ch. nootkatensis, Thuja gigantea,* and *Juniperus virginiana, Ch. lawsonia* deserve especial mention. It grows and flourishes practically everywhere in Germany: from Königsberg, in the east, to the Eifel mountains, in the west. It is noteworthy that this tree, which in America only grows in a relatively limited territory, should do so. The wood is very valuable for veneering as no German wood approaches it for this purpose. *Ch. nootkatensis* is more often met with; *Thuja gigantea* is also wide spread, but being more sensitive to cold is found at its best in South Germany in the warmer sections.

Of *Juniperus virginiana* which in general is a failure, the climate being too severe, the following interesting experiment must be related. As is well known better class pencils are made of the wood of this so-called Virgin "cedar," *Juniperus virginiana.* The A. W. Faber Company has been trying for a long time to acclimatize these trees in Bavaria, at Stein near Nürnberg, where their pencil factories are situated. About 1875 Lothar V. Faber planted an acre of 6 hectares or about 15 acres with them, having obtained seed in America, and cultivated the little plants in a nursery till they were 3 years old. Now the average height of the trees is 8 meters with a circumference of 55 cm. How far this attempt will be finally successful from an economic point of view can not yet be said, as the experiment can not be considered closed. The proof has been given, however, that *Juniperus virginiana* grows in Germany in forest conditions.

Of all American trees introduced into Germany *Pseudotsuga Douglasii* takes the first place; the variety *viridis,* as opposed to *glauca* which has not produced satisfactory results.

In all large German forests *Ps. Douglasii* has been successfully raised, has spread and is found mixed in with other forest trees pretty nearly everywhere. It is not sensitive to the severe early and late frosts which are common in various parts of Germany, the only things it can not stand are too great dampness in the soil, and sites exposed to high winds, such as, for instance, the coasts of Schleswig-Holstein. Care

should be taken, when raising *Ps. Douglasii* from seed to import this from that section of the Pacific Coast, situated on the western slope of the Cascade Range, in Oregon and Washington and in southern Canada, from the 45th-50th degrees of latitude, between Salem, Oregon, and Seattle, Washington, including Mount Olympus and Vancouver Island.

Thus many years' experience, and expert opinion concur in judging *Ps. Douglasii* the most valuable foreign tree in Germany, the results far outweighing the expense and trouble. It is believed that in a few decennials large portions of the German forests may consist of *Ps. Douglasii.*

Sequoia gigantea and *Sequoia sempervirens* are also met with in German parks and gardens, principally in south Germany, for instance, in the park of Count Berckheim at Weinheim, where a splendid grove is to be seen, and at the other extreme limit of Germany, in the island of Rügen at Putbus. I refer to *S. gigantea,* as *S. sempervirens* does not succeed at all, but generally dies before reaching any noteworthy size.

Tsuga canadensis and *mertensiana, Taxodium distichum* and *Larix* varieties, as, for instance, *L. occidentalis* are met with in various places, and several successful attempts have been made with *Tsuga,* but in general all the first mentioned trees serve well in parks decoratively, but have no noteworthy economic value, as they only flourish under restricted conditions and if mixed in with other trees.

American deciduous trees do not occupy quite as important a place in Germany as the *Coniferae,* yet a considerable number of varieties are to be found.

Robinia pseudacacia has been so long introduced and has spread so greatly, that it can almost be considered indigenous. It grows everywhere in Germany.

Quercus abound and belong to the most useful and admired of foreign trees, notably *Q. rubra* and *Q. palustris.* These trees are to be found in parks and scattered through all the large forests, where their brilliant autumn foliage adds much to the beauty of the landscape. *Q. rubra* has been cultivated for more than 100 years, flourishes even in poor soils, where the German oaks *Q. robur* or *pedunculata* and *Q. sessiflora* do not get along. It grows fast in the beginning, but the wood is not as good as that of the German oaks.

Besides *Q. rubra* and *palustris, Q. coccinea* and *Q. tinctoria* are frequent. *Q. alba* is in many parts of the country, but *Q. macrocarpa* only in the warmer parts of south Germany in the vineyard districts.

Q. coccinea and *Q. tinctoria* also get along well in damp, sandy soil and grow much faster than the German oaks.

Liriodendron tulipifera, a tree of greatest beauty, is also found everywhere in fine old specimens and all ages. In Wilhelmshöhe and Karlsruhe there are fine avenues of tulip trees.

American hickories, *Carya,* are also met with in various parts of Germany. They need good and rich soil and are, therefore, only to be found in fertile sections. *C. alba* is the most important. *C. amara, porcina, sulcata* and *tomentosa* have no particular value for Germany. *C. alba* does best in the Oder Valley, Breslau district, and in the meadows of the Mulde and Elster, Merseburg district. Even in East Prussia fine specimens of *Carya alba* are found, trees of over 100 years old, as, for instance, in *Gumbinnen,* planted between 1788 and 1799. The American maples, *Acer saccharinum* and *A. dasycarpum,* have also been considerably introduced. Compared with the German *Acer, A. campestre, A. platanoides, A. pseudoplatanus,* which are quite equal in growth and assimilation, *Acer saccharinum* and *Acer dasycarpum* are to be recommended rather for their beauty and rapid growth. They often attain considerable dimensions: an *A. dasycarpum* in the park of Count Berckheim, Weinheim, is 34 m. high and 2.10 m. in circumference.

Liriodendron, Carya and *Acer* are also distinguished by their beautiful coloring in the autumn.

The American white ash, *Fraxinus americana,* has flourished over 100 years in different parts of the country. In general it equals the German ash, *Fr. excelsior,* and surpasses it in its power of resistance to the effects of inundations and will grow in soils where *Fr. excelsior* can not exist. Trees 80-100 years old are as large as equal-aged German ash.

Juglans nigra is one of the most valuable of foreign trees and splendid examples are to be seen here and there. It assimilates itself well, but demands a good soil, and is perhaps the most difficult to raise of foreign trees of value.

Populus canadensis has been most satisfactory in South Germany. It grows very fast and produces a large amount of wood. In the forest of Count Berckheim, Weinheim, there is a *P. canadensis* 40 m. high and 2.50 m. in circumference.

Castanea vesca, var. americana, which although found here and there in the North or Central only flourishes in the warmer South and notably in Baden.

Prunus serotina, Catalpa speciosa, Magnolia hypoleuca are found in various parks and while *C. speciosa* and *M. hypoleuca* have no especial economic value, *Pr. serotina* has been quite extensively grown and used.

I will now recapitulate and name specific geographical localities and the trees growing there in the order of excellence.

Gadow, extreme northwest Brandenburg, adjacent to Mecklenburg on the Elbe.

Pseudotsuga Douglasii
Picea sitchensis
Tsuga mertensiana
Pinus strobus
Picea alba
Chamaecyparis lawsoniana
Thuja gigantea
Prunus serotina

Wendisch-Wilmersdorf, Brandenburg, southwest of Berlin.

Pseudotsuga Douglasii
Picea sitchensis
Larix occidentalis

Western portion of Pommerania, near Anklam, at eastern line of Mecklenburg. Because the German fir, *Picea excelsa,* does not get along, efforts were made to find substitutes. The following all did well and thrived.

Pseudotsuga Douglasii
Picea sitchensis
Abies concolor

Of deciduous trees the following are worthy of note:

Acer dasycarpum
Fraxinus americana
Quercus rubra
Prunus serotina
Juglans nigra
Carya alba
Castanea vesca

Northwestern Germany, Lower Rhine, near Cologne, Aurich, East Friesland.

Pseudotsuga Douglasii
Picea sitchensis
Thuja gigantea
Chamaecyparis lawsoniana
Pinus strobus
Pinus banksiana

Western Germany, Westfalia.

Abies concolor
Pseudotsuga Douglasii
Chamaecyparis lawsoniana
Thuja gigantea
Picea sitchensis
Pinus strobus
Pinus ponderosa

Of deciduous trees:

Acer varieties
Quercus varieties
Fraxinus americana

Gosda, near Spremberg, southern Brandenburg, Lausitz. Raw climate: In this section attempts were made to improve the value of the very poor quality of the local *Pinus* varieties, and to substitute other *Coniferae* for them.

Pinus banksiana
Abies grandis
Abies concolor
Pseudotsuga Douglasii
Picea sitchensis

Of deciduous trees:
Quercus rubra and palustris
Acer saccharinum
Prunus serotina

Oliva, West Prussia. Very severe climate, high winds.
Pseudotsuga Douglasii
Abies concolor
Chamaecyparis lawsoniana

Danzig, West Prussia. Somewhat less severe climate.
Pseudotsuga Douglasii
Picea sitchensis
Chamaecyparis lawsoniana
Pinus strobus
Quercus rubra

Königsberg, East Prussia. Severe climate.
Abies concolor
Pseudotsuga Douglasii

Klingenberg, S. W. Germany.
Pseudotsuga Douglasii
Pinus strobus
Chamaecyparis lawsoniana
Picea sitchensis
Tsuga mertensiana
Abies concolor
Pinus ponderosa
Quercus rubra and palustris
Liriodendron tulipifera

Baden, S. W. Germany.
Pseudotsuga Douglasii
Abies grandis
Picea sitchensis
Picea pungens
Abies concolor
Abies nobilis
Pinus strobus
Chamaecyparis lawsoniana
Thuja gigantea
Quercus rubra
Quercus palustris
Carya alba
Castanea vesca
Juglans nigra
Populus canadensis
Fraxinus americana
Robinia pseudacacia

Of which the following are best:

Quercus rubra	Juglans nigra
Castanea vesca	Robinia pseudacacia
Thuja alba	Populus canadensis

Weinheim, Hessen. Very mild climate.

Pseudotsuga Douglasii	Sequoia gigantea
Abies concolor, grandis	Acer dasycarpum
Chamaecyparis lawsoniana	Liriodendron tulipifera
Thuja gigantea	Populus canadensis
Juniperus virginiana	

Württemberg.

Pseudotsuga Douglasii	Abies concolor
Chamaecyparis lawsoniana	Juglans nigra
Picea sitchensis	

Augsburg, Bavaria.

Pinus strobus

Upper Isar Valley, Bavaria.

Pseudotsuga Douglasii	Chamaecyparis lawsoniana
Pinus strobus	Picea sitchensis
Abies concolor, magnifica, nobilis	Quercus rubra
	Fraxinus americana

I can not close this article without referring especially to the German Dendrological Society and its indefatigable President Count Schwerin. This Society was founded in 1892 and has now over 4,000 members. It publishes very valuable yearly reports covering the whole field of dendrological effort, as far as obtainable, and has accomplished great things for dendrology in Germany. Most of the data contained in this paper were obtained from the above mentioned reports and from information gathered on the annual trip made by the Society to South Germany in August 1922.

WEST VIRGINIA FORESTS AND FORESTRY*

By Thos. W. Skuce

As the first settlers pushed westward into Westphalia, as that part of Virginia was then called, they found the area which was later destined to become the State of West Virginia a veritable wilderness with its hills and valleys covered with a dense forest cover. This was a situation no different than had confronted the first settlers on American shores so like their fathers these early pioneers had to cut, hew and burn sufficient acreage to assure themselves a means of livelihood. As the fertility of the cleared hillsides became exhausted the process had to be repeated. Such a practice soon brought about through these circumstances a general hatred for the woods. This attitude has been handed down through the years.

After having an area cleared, annual burnings were resorted to in an attempt to insure pasture acreage. As a result it has become an accepted legitimate practice to the farmer in the hills for a means of an imaginative improvement of his fields. In reality it is exceedingly detrimental in the end even though there is a slight improvement in the immediate condition of the forage. Repeated burning soon removes all vegetation and exposes the mineral soil. This causes waste land, loss of revenue, land erosion, and the encumbrance that idle land entails. Idle land is worse than no land at all since in the latter case no taxes have to be paid.

This condition has been disappearing down through the years as people met the market demand for hardwood timber. Far sighted companies secured huge tracts throughout the state. Sorry to say they did not continue their farsightedness when they began their logging operations. They supplied the immediate market with no thought for the future and this is the problem that is for us to solve to the best of our ability.

Clear cutting and taking only the choicest was the policy. So far as operations are concerned, this is the real cause for the acute situation in the industry today irregardless of locality. Once a tract had been cut over nothing remained, so by necessity a new location had to be sought.

Today West Virginia is dotted with thousands of barren acres and hundreds of deserted lumber camps. In a state having a 15,-

*Read before the Allegheny Section, Harrisburg, Pa., March 6, 1924.

360,000 acre forest cover representing 99 per cent of her total area there are 4,634,000 such acres and some 2,175 idle camp sites all due to this short sighted cutting policy. Restoration of this acreage to its original production of timber and the wise administration of the 8,000,000 acres remaining form the basis of the problem in West Virginia today.

Some of the topographical features may in a way aid in the realization of what there is to be expected within the state. There is a vertical drop from Spruce Knob, Pendleton County, at 4,860 feet to Harper's Ferry, Jefferson County, which is only 240 feet above sea level, of 4,620 feet. The range of latitude varies from 12 to 15 degrees while the rainfall in the southern counties ranges from 25 to 38 inches per year with a variation in the northern tier of 36-55 inches, averaging for the entire state close to 48 inches per annum.

With such conditions existing it is easy to understand how easily West Virginia lends herself to a common meeting ground for the various types of forest growth as we recognize them today. Here are to be found a variety of forest products which are more often to be associated with the territories extending well within the Canadian border and south beyond Virginia.

From a point of natural resources West Virginia ranks third among the list of states. Pennsylvania is first due to her vast anthracite coal deposits, Oklahoma second through her great oil reservoirs, and West Virginia third due to her coal, oil, and timber in the order named. The recent final quarterly report of 1924 from the U. S. Chamber of Commerce shows that West Virginia advanced her standing for the year from 22nd to 20th place in the list of exporting commodities. This was largely due in the first place to the coal moved but more particularly to the place lumber and paper products have assumed.

This is as it should be for lying as she does on the Alleghany Plateau, West Virginia in a general way slopes from the east line of the state northwestward to the Ohio and Big Sandy rivers. With the higher elevations of this plateau timbered as they are in spruce, hemlock, and hardwoods, and the proportion of hardwood increasing lower down the slopes until we find the lower elevations claimed entirely by these latter species, this quantity and value of forest products in West Virginia will gradually tend to increase under proper

management, protection and equity in taxation which are problems that must be solved.

We can not afford to disillusion ourselves of the fact that in a state such as West Virginia such questions as those just cited form vexing obstacles in the light of the fact that 10,240,000 acres of the state's area is underlaid with coal, all of which is mineable. This fact militates for high land values and correspondingly high tax valuation and levies.

Something of the future value of the state's forests were being experienced even forty years ago, judging from the timid remarks made by old residents, but even they did not realize that in a few short years West Virginia timber would be occupying such a prominent place among the indispensable articles of consumption such as it does.

By 1892 we find that some of the companies had adopted a policy of cutting nothing smaller than 44 inches in diameter inside the bark 24 inches from the ground. Since several of these same companies do not cut pulp or chemical wood all trees below 14 inches are left. This policy was of an economic necessity but so far has proven itself in leaving the forest in excellent condition for a new crop of saw timber in 30-40 years. This would be different on a tie and pulpwood operation but where such a type of an operation has been followed as originally cited it has not been uncommon for tracts so handled to be ready for a second cutting in 20-25 years where fires have been kept out.

As time passed and timber lands became more valuable lumbermen and others realized they had a pretty large investment on their hands so began investigating ways and means of perpetuating their holdings. These investigations proved what a folly the old "Guess So" policy had been to such an extent that today the larger timber holders, as well as several of the coal companies, have in their employ technically trained foresters so that it has been primarily the private owner who has developed the real practice of forestry so far as it has gone in West Virginia today.

Nevertheless public sentiment was not entirely latent concerning this question for in looking over the annual recommendations of the, then, State Board of Agriculture, in its annual report for 1898 it is interesting to note that it suggests that "Owing to the rapid destruction of our forests it is high time that something be done looking

toward the preservation and protection of our timber lands." The same and similar suggestions have been carried in the report of the State Agricultural Experiment Station but action has been slow in materializing due to a large measure to the early experience of the citizenry in settling the country, with poor roads into the mountainous country, and the fact that the centers of population were along the waterways, hence these groups were not so intimately tied up in the industry. Just as the state's road program has advanced so has the public sentiment advanced in its demand for adequate protection for the remaining timber. So again it goes back to the problem of education which is always the basic factor in the launching of any worth while program.

During this period great areas of pine and spruce were noted as being in a dying condition so that the State Experiment Station went to some length to seek a solution and find a remedy. Incidentally in conducting these investigations additional work in other species was found to be unnecessary. Results showed an infestation of Dendroctonous beetles. Much time was spent in solving the situation. Clerids were brought in from Europe and released. As the situation cleared the Station's attention turned to some of the more pressing problems that were confronting it at that time.

From this time on interest in forests and things of nature were not given much thought by the people largely because there was nothing to crystalize sentiment so the entire field lay dormant until 1908 when Pomona Grange No. 2 called a meeting of all citizens interested in forestry to meet in Morgantown for the purpose of organizing the West Virginia Forestry Association. This body flourished for a few years but like everything else the burden was carried by a few. Those few were successful in laying a stepping stone for a survey of the West Virginia forests which was published in 1911 and is now listed as Volume Number 5 of the West Virginia Geological Survey Report. In furtherance of the cause of conservation and as a particular study the state cooperated with the Federal Forest Service in making a detailed study of the Wood Using Industries of the state, as well as one on the Marketing of Farm Timber in the state.

This latter phase of the cooperation is of much interest just as this time when better than one-third of the remaining timber area of the state lies on the farm. And what is true of West Virginia is true of the country at large in this respect.

Cooperation between the state authorities and the U. S. Forest Service continued intermittently from then until the present time.

Soon after the passage of the Weeks Law of 1911 National Forest areas within the state were set aside, until the end of 1923 found some 218,000 acres so designated. During the year just passed 14,760 additional acres were set aside and recent announcement has it that 2,500 acres more will be added during 1925.

Becoming alarmed at the losses caused by the annual forest fires throughout the timber sections of the state timber land owners decided to take some action and this they did by forming the Central West Virginia Forest Fire Protective Association in 1914. By 1916 a similar organization had been effected to the south of the Central Association holdings known as the Southern West Virginia Forest Fire Protective Association.

Progress in development was irregular for several years, and from 1918-1920 these organizations functioned only poorly. The equipment was in poor condition and the fighting force was decidedly weak in morale. Effectual planning and supervision were apparently lacking and the entire movement appeared to be on the verge of collapse.

During this same period there had been active a group of ardent sportmen whose pleasure was fast being denied them by these same fires. They were all good business men and knew full well that only by some concerted state action could the situation be remedied. It is through their efforts that the bill creating the present Game and Fish Commission had its inception.

This commission derives no revenue whatsoever from a direct tax levy but from the hunting and fishing licenses that are paid in each year. One of its main duties is the administering of an efficient forest fire protection system for which 25 per cent of the license money may be spent.

When the commission began to function in 1922 it found that so far as a forest fire protective system was concerned it had fallen heir to 16 wooden towers and 12 patrol routes. The towers were run down and poorly equipped and the morale of the personnel was in about the same condition. At the present time there are 35 towers all well equipped properly manned and a complete telephone circuit connecting them all up with ranger stations and sources of help.

During this interval another protective association area has been formed in the Eastern Panhandle of the state. While this associa-

tion is not as large in acreage as the others, nevertheless it has a larger number of cooperators due to the large number of small woodlot and orchard owners who are seeking protection.

The system has worked so admirably to date that now it is planned to extend the line of endeavor to include the whole state. In preparation for such a move there is now before the state legislature a bill embodying many of the features of the Oregon law. It has received the endorsement of all the agencies within the state who are vitally interested in its enactment.

The Game and Fish Commission are also empowered to purchase forest and wild lands for the furtherance of all forms of wild life. In accordance with this provision a tract of 10,847 acres was acquired about a year ago in Pocahontas County and only recently has the commission provided for an additional purchase of 4,546 acres in the same county. These areas both are protected from a tower recently erected in the larger tract.

Since being favored by location, climate, and other physiographic features where hardwoods will reproduce themselves if given efficient protection from fire, it is easy to appreciate that 90 per cent of our problem is *Fire Prevention.* Consequently we are bending our efforts in support of the pending measure now in the hopper at Charleston.

Planting, experimentally by some companies, has been done in the past but fire seems to have burned over these areas. One at Winterburn has been fortunate enough to escape. It was one made at an elevation of about 3,000 feet near the lower limit of red spruce on a low flat ridge. European larch, Norway spruce, and black locust were used. On the flat ridge where the hardwoods are patchy and 15-25 feet tall the softwoods are doing best. Larch 15 years old have averaged 15 inches D. B. H. and 18.7 feet tall. The terminal growth for 1923 was 2 feet. Spruce has a height growth of 5.7 feet and a terminal growth of 1.6 feet. Black locust was a failure, only 10 to the acre. Such a practice has not been successful in the United States to date but it is not impossible that there are areas where such a method of restocking would be feasible.

Timber lands in West Virginia up to a few years ago were in the speculative stage and considerable money was made in the lumber industry from a rapid rise in stumpage values. This stage is now past as it is in the eastern states generally and has now reached the purely investment era, due to the fact that the virgin timber is practically

gone and the lumberman is having to depend upon the annual growth. Land values, rates of taxation, ownership problems, cost of protection to say nothing of the insidious workings of compound interest together serve to distort the vision of the silviculturist.

Consequently in the hardwood region of West Virginia under existing conditions it seems only feasible for the holder to grow his stock from natural seedings in short rotations for mine props and pulpwood while in spruce lands either clear cut with strips allowed for reseeding under a selective system or cut clean and turn the area over to the government to be restocked with faster growing species. Right in this connection it might be interesting to note the fact that neither the White Pine Blister Rust which has killed 50 per cent of the White pine nor the Spruce Bud Worm which has destroyed 30 per cent of the spruce in Maine have reached West Virginia as yet. Only proper precautions will prevent their entry.

All these various situations present problems that take time and effort to solve and in the endeavoring to find a solution to the multiplicity of questions presented the various Forest Experiment Stations have a very hard time to decide upon what should receive first consideration. Often this quandary has led the various stations far afield when it came to producing results that would aid in solving the situations at hand.

To avoid such occurrences and as a part of a comprehensive plan to bring out the practical feature of the research work in forestry and to keep the foresters in close touch with the region which they serve, Research Councils have been appointed to function in cooperation with the Southern Appalachian Experiment Station, the southern pine region and in the Pacific northwest.

Organization of the Southern Appalachian Council took place recently being the first of the three to begin functioning. Such a group of men representing the diverse interests into which our forests enter can only revert to a strong constructive policy that will tend to suggest problems that will really be of a genuine aid in untangling a bad situation. They are men who are actually on location as it were and are up against the real problem day in and day out. When these are on the road to solution the mission of the Forest Experiment Station will have been found.

While these federal stations are trying to solve some of the regional problems our own Experiment Station within the state will

endeavor to get hold of her own boot straps by practices that are hoped will clear up in our own minds questions concerning growth, utilization, nursery practices, forest management, disease control, protection, and taxation.

Such a program will be assured by the continuance of the educative agencies which have been at work in the state during the past few years. They have lighted the lamp of conservation and now by carefully trimming the wick through an intelligent solution of our situation we will make the light of conservation burn more brightly in West Virginia.

BJURFORS KRONOPARK*

A Swedish "Forest School Demonstration Forest"

By J. H. Allison

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This Forest (Kronopark) is one of the four Forests, all located in Central Sweden, which have been assigned to the Forest School (or College of Forestry) for school demonstration purposes. The records indicate that this one was purchased especially for this purpose. The Forest School students receive a part of their field training here, coming in groups of 15 to 20 men, one group each summer, and staying for a period of two months. Among the lines of work studied here are planting and seeding, forest and swamp ecology, drainage and charcoal making. One of the seven Swedish Ranger Schools (each candidate for the position of Ranger must spend a year in such a school) is also located on this Forest. The quarters of the two groups of students are adjacent to each other, the Forest School men using the old Manor House and the resident Forester and Ranger School men using new buildings near by.

Originally this Forest was assigned to the Dean of the Forest School for administration and management, but some years ago, when the Ranger School was established here, responsibility for the administrative and management work was transferred back to the Domanstyrelse (The "Domanstyrelse" is the Swedish equivalent of the U. S. Forest Service) which assigned it to the Forester placed in charge of the Ranger School.

A more detailed description of this Forest is now in order. It is located about one hundred miles northwest of Stockholm, in the middle part of the Dal Valley, between the towns of Krylbo and Norberg. It covers a compact tract of 16,222.8 acres, roughly rectangular in shape. Of this area, 11,520 acres are in productive forest; 1,370.8 acres in cultivated lands, most of which is included in 11 farms, but part of which goes with the nine houses for woods workers; and 3,332.0 acres is non-productive lands. No changes will take place in these areas in the near future because all of the lands that are better suited to cultivation

*"Kronopark," in Swedish, is the equivalent of "National Forest" in American, and the word "Forest" will be used throughout this article as its equivalent.

Note—Much of the above information was obtained from "Beskrioning over Skogshogskolans Demonstrationsskogar," Svenska Skogsvardsforenigens, 15th exkursion, 1921.

than to timber production are now being farmed, and the non-productive lands are almost entirely made up of peat lands of the muskeg type which can not be profitably drained or otherwise made productive under present conditions.

The area covered by the Forest is a low rolling upland whose elevation lies between 425 and 500 feet above sea level. Only in a few places does the bedrock, in which a dense fine grained kneiss predominates, reach the surface. The soil is mainly composed of morainic material, only slightly waterworked, which is covered by a thin layer of clay laid down during the time that this area was covered by the sea at the time the ice was melting away at the end of the ice age.

The greater part of this Forest was purchased by the State, in 1894, for $103,716.00. In 1903 a small addition was purchased at a cost of $7,236.00. Hence the first cost of the whole Forest, land, timber, farm buildings, and a large "manor" house of 16 rooms was $110,-952.00, which amounts to $6.91 per acre for the total area purchased, and to $8.05 per acre for the productive lands (the buildings being thrown in). The buildings acquired along with the land were worth more than half of the price paid for the property. The low price for which the former owners sold is probably accounted for by the fact that it had been used mainly for the production of charcoal, the market for which was then being seriously curtailed in the late eighties and through the nineties, by the competition of coke. Because of the youth of the stands upon this Forest the financial future of the property, at that time, did not look very bright. The owners undoubtedly thought that they were unloading onto the State an unprofitable investment. But the investment ultimately proved a profitable one to the State for it has more than paid operating expenses each year since its purchase, with two or three exceptions, and during recent years the net income has often amounted to 25 per cent upon the original investment.

Considering its area, probably more drainage work has been done on this Forest than upon any other. The drainage operations undertaken have been very successful. Between 1,000 and 1,200 acres, which is about 10 per cent of the area of the productive forest land, have been successfully drained and are now covered by vigorously growing, very productive mixed stands of birch, spruce and pine. Drainage has been accomplished by digging open ditches about three feet in depth and two feet in width at the bottom. Sometimes these ditches have perpendicular sides and sometimes sloping ones. In drainage work it is considered of great importance to dig first the ditches around the margin

of those parts of the swamp being drained where the water is moving down into the swamp from the surrounding higher lands. After the flow of water into the swamp from the surrounding lands has been stopped, the interior ditches necessary to complete the drainage of the swamp are dug. Much of the earlier drainage work, both here and elsewhere, was a failure, because no marginal ditches were provided to catch the water moving down into the swamps from surrounding higher land. No attempt is being made to drain swamps of the muskeg type. Drainage is confined to wet or swampy lands in which the ditches will penetrate mineral soil before reaching a depth of three feet. The lands actually drained are becoming the best sites in the Forest. Following the completion of the ditches, it is considered of great importance to get established as quickly as possible a good stand of birch amongst which is mixed some spruce and pine because it is believed that the birch by means of transpiration through its large leaf surface helps greatly in drying out the swamps. Between 1897 and 1920, 415,233 feet (138,411 yards or 78.6 miles) of new ditches were dug at a total cost of $6,798.59 (average cost 4.9c per yard). During the same period 219,195 ft. (73,065 yards) of ditch was cleaned at a cost of $2,236.65 (or 3.6c per yard). Also during the same period 23,873 feet (7,958 yards) of stream courses were cleaned and deepened at a cost of $576.15 (7.2c per yard). The digging of new ditches was carried on most vigorously during the years 1901 to 1904 inclusive. During these four years about 50 per cent of the total length of new ditch was constructed. The cleaning of these ditches has assumed relatively greater importance during recent years. As might be expected the per yard cost of new ditching was considerably lower during the earlier part of the period than during recent years.

Both market and marketing conditions for the forest products here produced are very favorable. These are iron mines nearby to the Southwest and iron foundries to the Northeast. These mining and foundry towns furnish good markets for charcoal, firewood, mine timbers, sawdust and considerable lumber. The lumber which they can not absorb can be easily shipped by rail to one of the Baltic ports or to Gothenburg. The Forest is traversed by a railroad which has three stations within its boundaries, and by a well graded, gravel surfaced road with graded and ditched branch roads to each of the farms. During the last twenty years a good system of logging roads has been established all over the Forest. These roads lead directly to the sawmill at Bjurfors (the headquarters of the School and Forest) or to a small lake about two

miles away. This lake is connected to the mill by a drivable stream and provides a favorable place for the storage of logs until such a time as they are wanted at the mill. The mill is a steam power one, equipped with one standard type Swedish "ram" head saw, a re-saw, an American type of planer, an ample log pond, an ample yard, and a private railroad switch. This mill was built and equipped by the State in 1912 at a cost of about $12,000. At the present time about 30,000 logs, amounting to about 825,000 ft. B. M. are milled here each year. As far as it has been feasible to do so, the logging roads have been located upon the upland, because they must be used in the fall before the ground freezes up to haul out charcoal, as well as in the winter time to haul out logs and firewood. The charcoal and firewood cuttings are scattered all over the Forest in order to provide the farmers and permanent workers living in the houses belonging to the Forest with work within walking distance of their homes.

The Forest, considered as a whole, is a mixed one of pine, spruce and birch, the pine predominating. For the most part the stands are of even age, the 61-80 year old (IV) age class now predominating. There is a marked deficit in the 1-20 year old (I) and in the 101-120 year (VI) age classes. The even aged form, so extensively found here, was brought about by the clear cuttings formerly made in connection with charcoal making. At the time (1894) this property was purchased by the State, about 80 per cent of its productive area was occupied by stands in the I (1-20), II (21-40), and III (41-60 years old) age classes. Since it takes from 100 to 120 years under local conditions to grow satisfactory sawtimber, it will be seen that this Forest at the time of purchase, was a young one.

A working plan for this Forest was prepared in 1912. While stock taking for this working plan was in progress, base lines running parallel to each other in a true north and south direction were cut through the Forest at 1,000 meter intervals. These base lines are still in good condition. The actual cruising of the stand was done by calipering strips run at right angles to these base lines. The division of the Forest between the different age classes was then found to be as shown in the accompanying table.

The deficit in age classes V and VI, which furnish practically all of the sawlog material is very noticeable. At that time the total volume of wood standing on this Forest was estimated at 16,767,500 cu. ft. (approximately 186,300 cords.) Hence the average stand per acre of productive forest land then amounted to 1,443 cu. ft., or about 16 cords.

The Forest has just been remeasured and a revision of the old plan which practically amounts to a new plan is now being prepared.

Age Class I	(1-20 years)	9 per cent.
II	(21-40 years)	20 per cent.
III	(41-60 years)	25 per cent.
IV	(61-80 years)	35 per cent.
V	(81-100 years)	10 per cent.
VI	(101-120 years)	1 per cent.

Perhaps the development of forest management upon this Forest can be most clearly shown by a brief history of cutting operations carried on since 1895. During the first ten years (1895-1905) cutting was confined to light cuttings in the understory of the Forest and to the taking out of scattered mature or near mature seed trees standing upon recently cut-over areas upon which satisfactory reproduction had become established. The thinnings made during the period were so light that they probably had very little effect upon the growth of the stand. The average annual cut was 163,015 cu. ft. (or about 1,800 cords). In 1906 the rate of cutting was considerably increased, being raised to 336,550 cu. ft. (or about 3,400 cords) per year. And the thinnings to produce this volume were extended to the upper story of the Forest. This method of cutting increased the rate of growth of the stand. In 1908 new growth and volume data were collected and as a result the annual cut was still further increased. This time to 421,482 cu. ft. (or about 4,680 cords) per annum (1909). Three-fourths of this cut (volume) was obtained from thinnings, while final cuttings provided one-fourth. This rate of cutting continued during the four-year period 1909-1912. By 1912, thinning operations had been extended over the entire Forest. Since that date, each stand, beginning at the age of 25 years, has been thinned at 10-year intervals. These thinnings have yielded more material than they were expected to and consequently the cut has been gradually increased to about 460,000 cu. ft. (about 5,100 cords) or about 0.44 cords per acre per annum. As yet final cuttings have been made only to a very limited extent. Such cuttings are, for the most part, confined to the poorest sites, but some of the better sites have been included in order to give the students areas upon which to practice forest planting or seeding. The larger material, except such as is very defective, is cut into sawlogs if it will cut a sawlog six inches in diameter inside the bark at the small end and 10 or more feet in length. The smaller material is cut into "pit props" (mining

timbers for export to the English coal mines), firewood and charcoal wood. The poorest, smallest material is used for charcoal, pine and spruce being preferred over birch because they contain less sulphur and phosphorus and crumble less in transit and while being fed into the iron furnaces.

Conditions on this tract are very favorable to natural reproduction, the greater part of the present stands having originated in this way During the last 10 years several small areas have been cut almost clear, only a very scattered stand of unusually vigorous and finely formed pines being left. These trees are left, partly for the purpose of seeding the ground thus cut over to pine and partly for the purpose of producing unusually fine quality logs through the accelerated growth which follows the freeing of such trees from all competition. Some very fine stands of pine reproduction have been secured in this way. Pine (*P. sylvestris*) is the most valuable tree which grows in this district, so every effort is made to encourage its reproduction. The spruce (*P. excelsa*), during youth, is very seriously injured by spring frosts if growing in the open. However, this species seeds vigorously and can be depended upon to come in under the pine and birch almost everywhere. When protected during youth, it grows into a very well formed tree. Stands of young timber have been established by planting or seeding (mostly by seeding using the seed spot method) upon all of the productive forest lands which were treeless at the time this property was bought. This planting and seeding work was done by students as part of their school training. Now it is necessary to clear out small areas of land each year in order to provide the students with training in planting and seeding.

Omitting the men who are temporarily located on this Forest for the purpose of teaching the Forest School students who come here each summer, the Forest staff is made up of a Forester (Jagmastare), a Junior Forester (Young Jagmastare), and three ordinary and two extra Forest Rangers (Kronojagare). This force must administer the Forest and take care of the instruction work in the Ranger School.

The Ranger School work occupies all of the time of the Junior Forester and that of one of the Rangers and much of the time of the Forester. The sawmill occupies the full time of another of the Rangers. If there were no Ranger School here, this Forest of 16,222.8 acres would, under local market and forest management conditions, occupy the full time of the Forester, three Rangers in the woods, and one Ranger at the sawmill. Hence, counting out the Ranger at the sawmill, the

area of the average ranger district in this Forest is 5,407.3 acres of which 3,840.0 acres is productive forest land.

With the exception of a very small amount of special sized material sold on the stump, all of the timber cut upon this Forest is worked up into charcoal, pit props, firewood or lumber, by a force of woods and mill laborers working under the direction of the Forester and the Rangers. During the sawing season (spring and fall) 17 men are employed at or in the mill. During the rest of the year these men are employed in the woods as timber cutters, ditch diggers, road builders, etc. Ten of these men live in houses belonging to the Forest. With each of these houses goes several acres of land where the workers' families can raise vegetables for themselves and hay and grain for a cow, one or two pigs and some chickens. There are also 11 farmers living on the Forest. Each of these farmers has one or more horses. They are required by the contract under which they rent their farms to do a certain number of days' work, at a prearranged wage rate, per year in the Forest. These men do most (often all) of the charcoal making and hauling and the log hauling. They get in six or eight months of woods work a year. In addition to working in the woods, these farmers cultivate an average of about 115 acres of land apiece. Their houses and those of the woods-mill workers are well built, comfortable, neat looking three or four-roomed frame houses with tile roofs, which, under present conditions, cost from $2,000 to $3,000 apiece to build. The Rangers are provided with similar houses, but with only about two acres of cultivable land. They are not allowed to keep a cow—because they might spend too much time looking or caring for her, thus slighting their work. The Forester is provided with a large, attractive house. In addition to the houses provided for the farmers, woods workers, etc., four large cabins designed to house eight men each have been built in different parts of the Forest. These cabins provide quarters for temporary extra laborers, who, for the most part, are employed in the winter time at woods work. From the foregoing figures, it will be seen that this Forest, covering 11,520.0 acres of productive forest and 1,370.8 acres of cultivated land, gives continuous employment to 33 men, nearly all of whom are married and have families. This works out at the rate of one man to each 394 acres of productive land. Besides, the woods give temporary employment to 12 to 20 extra men during the winter season—that is during a period of about three months

Several small areas have been planted, in an experimental way, to foreign species. The American species which have been tried are white pine (*P. strobus*), Engelmann spruce (*P. engelmanni*), Colorado blue spruce (*P. pungens*), (*P. murrayana*), and balsam fir (*A. balsamea*). None of these species is making satisfactory growth. The only foreign species that is growing faster than the native pine and spruce is the Siberian larch (*Larix siberica*). This species seems to have a bright future here.

It has already been stated that this Forest has been made to pay its way ever since it was purchased. The financial results obtained are interesting and are shown, at five-year intervals, by the following table.

FINANCIAL RESULTS 1897-1920

Year	Volume Cut Cu. Ft.	Total Income	Total Expense	Net Income	Net Income Per Acre of Prod. Forest Lands
1897	122,913	$ 6,817.04	$ 4,441.19	$ 2,365.85	$ 0.205
1905	168,830	6,746.90	4,927.18	1,819.72	0.158
1910	384,845	17,036.22	12,187.48	4,848.74	0.421
1915	552,930	46,022.03	20,005.31	26,017.72	2.258
1920	326,910	83,884.00	49,312.00	34,572.00	3.001

FORESTS, HUNTING AND FISHING FROM THE ECONOMIC VIEWPOINT IN BELGIUM

By L. Drumaux

Principal Inspector for the Minister of Agriculture

Translated by H. T. Gisborne, Priest River Forest Experiment Station

The necessity of forests in the existence of a people no longer requires demonstration. Nations are commencing to take into account the tremendous consumption of wood in this world, the exhaustion of forest products, and the increasing scarcity of this premiere material for which the human race would have so much difficulty in artificially supplying any deficit. This reason in itself is sufficient to justify the conservation of forests.

But the use of these materials is indispensable in maintaining man's natural demands for habitability. Furthermore, they are of value for defense in case of war. Their inconsiderate destruction has a profound effect upon the weather, upon stream flow, and leads to the sterility and ruin of regions which are deprived of them. To these economic, hygienic and strategic reasons it is necessary to add those imponderable values which belong to the history and character of a region, of a site, of a community, and of the entire nation.

It is lack of appreciation of the role of forests that so seriously compromises the future of new countries when they permit the destruction of these forests under the pretext of exploitation, colonization and civilization. In ruining the reserves of forest materials an immense wrong is done to the large cities where the necessarily reduced forest areas cannot suffice for the needs of a dense population.

In the following article there are assembled a few figures relating to the forests, hunting and fishing of Belgium. The reader, advised by that which has been said and knowing that the forests of Belgium occupy in general only the poorest lands, can do well to conclude with us that beside the numerous benefits which cannot be translated into money values the forests supply a very important balance to our own demands and to our commercial relations, and that we ought to force ourselves to conserve them, to improve them, and to extend them in every way possible. We ought to be especially economical in cutting, for the richer the forest—in large trees—the more they produce in quantity and qual-

ity of materials. If is the tenacious application of this principle which can gain for us in volume production that which we cannot gain in surface area.

ADMINISTRATION

The execution of the laws and regulations pertaining to forests, hunting and fishing is the function of the Administration of Waters and Forests, which is under the Minister of Agriculture and Public Works.

The woods and forests of the state, the towns and the public establishments are under management by foresters according to the principles of forestry. The foresters assume the entire management of the first mentioned class, and exercise their tutelage for the latter two classes, thereby assuring the supervision and care in exploitation conforming to the forest code; the cost of supervision and guardianship being returned to the state in the form of taxes by the proprietors affected.

The woods of private owners are not submitted to any jurisdiction except the law of January 28, 1921, which imposes some restrictions as a curb on the complete devastation of forest properties.*

For the woodlots submitted to forest regulation (towns and public establishments), the state assists by means of subsidies in the work of improvements or reforestation as follows:

One-half the cost of planting waste lands.

Three-fourths the cost of necessary improvements on sandy soils.

One-half the cost of restoring run-down coppice by the introduction of resinous species.

One-third the cost of creating an understory of broad-leaved species in resinous high forest.

One-fourth the cost of supervision by a forester.

PERSONNEL, AGENTS

The central administration consists of a central office with four divisions, including altogether about 15 agents of various grades—general inspectors, principal inspectors, etc.

The provincial administration consists of 11 inspection districts, each having in charge an inspector or a principal inspector as its head.

*Translator's Note:

The law mentioned was the outcome of excessive clear-cutting on private properties resulting from the exceptionally high prices obtainable at that time. It does, in fact, lay down certain principles of forestry which must not be violated even on private forest properties, and insures the supervision required for enforcement. The law is temporary in its duration, but has twice been prolonged since its initial passage, and is still in effect.

Each of these inspection districts includes three or four sections, in all 28, each managed by a section chief with the grade of principal guard, or, under inspector of waters and forests.

The provincial administration also includes a special branch of scientific research for consultation on forestry subjects.

The government of Eupen-Malmedy includes an inspector and four section chiefs, these officers having been recruited from the Belgian provincial administration.

The agents of the central and provincial administrations, to the number of about 70, including the assistant principal guards, have been recruited annually from among the agricultural and forest engineers. Their definite appointment to office is obtained only after they have shown professional aptitude following a period of three or four years in the various branches of the service.

OFFICERS

The sections, mentioned above, are in their turn, subdivided into brigades, each including three or four foresters whose titles are brigadier, brigadier guard, or forest guard. There are about 660 such officers, including the supernumerary forest guards.*

All these officers are recruited, if possible, from among foresters who possess a certificate of ability in silviculture, which is obtained by examination following special courses of instruction and practical exercises.

UNIFORM

In service, the agents and officers of waters and forests wear a military uniform corresponding to their grade.

EXTENT AND SUBDIVISIONS OF THE FORESTS

The forests of Belgium occupy an area of 521,199 hectares (1,287,361.53 acres), or about one-fifth of the cultivated area, and 17.7 per cent of the superficial area of the entire country.

The forests are divided by ownership as follows:

OWNERSHIP OF FORESTS

Ownership	*Forest Area, Hectares*	*Per Cent*
State	39,816	7.7
Towns	169,744	32.6
Public establishments	7,930	1.5
Private	303,709	58.2
Total	521,199	100.0

*Translator's Note:

Six hundred and sixty plus 70 equals 730 forest officers. The total forest area of Belgium is given further on as 1,287,361.53 acres.

These forests occupy, by broad-leaved and resinous types, the following areas in the various provinces:

FOREST AREAS

Province	*Broad-leaved, Hectares*	*Resinous, Hectares*	*Total, Hectares*
Luxembourg	122,527	50,188	172,715
Namur	96,607	11,252	107,859
Liege	43,841	18,159	62,000
Hainaut	42,923	3,055	45,978
Anvers	8,425	33,014	41,439
Limbourg	5,773	34,843	40,616
Brabant	18,515	8,685	27,200
Flandres, oriental	6,274	6,558	12,832
Flandres, occidental	6,634	3,926	10,560
Totals	351,519	169,680	521,199

Among the resinous types the "pessieres" (spruce stands?) are almost exclusively confined to the higher country, while the pine stands are especially extended at the lower elevations. More than 85 per cent of the broad-leaved area is found in the provinces of Luxembourg, Namur, Liege and Hainaut. These stands are the descendants of the old forests of Ardennes and Charbonniere.

The figures given are approximately those of the last general census of 1910. But after the devastation resulting from occupation during the war, and the exploitation which has followed the armistice, the extent of the resinous high forest has been reduced to about 158,000 hectares, and that of coppice and standards (which was about 198,245 ha.) has been reduced to about 170,000 hectares, or a total reduction of about 39,000 hectares. The present area of productive forest is thus more nearly 480,000 hectares, which corresponds to the status of the year 1846. This formidable shrinkage is happily in large part compensated for by the wooded areas of the redeemed cantons of Eupen-Malmedy, which include about 30,500 hectares, the state owning 10,500, the towns 16,000, and the private individuals 4,000 hectares.

PRODUCTION

The mean annual production of workable wood of all species and grades (construction timber, lumber, mine props, etc.) amounts to a total of about 750,000 cubic metres. If one includes fire wood as well as products of the tree plantations along roads, and other ornamental plantations, including parks, etc., then the production easily reaches a total of a million cubic metres per year. At a minimum value of 50 francs per cubic metre on the stump, this means a lump sum revenue of 50,000,000 francs.

In its manufactured form this material will have a value of five or six times the above figure.

IMPORTS

In 1920 Belgium imported as construction wood, oak, walnut and others, a total of 760,850 cubic metres, or about the same amount as the current production. These imports, however, were more or less manufactured and their value amounted to an average of 342 francs per cubic metre. In 1913 these imports amounted to 1,750,772 cubic metres with an average value of 63 francs per cubic metre.

In other wood products, including mine timbers, the 1920 imports amounted to 89,705 tons at 129 francs per ton, as compared with 414,328 tons at 33 francs per ton in 1913. Pulp wood imports totaled 117,225 tons at 1,384 francs per ton, against 132,400 tons at 222 francs per ton in 1913.

The decrease of imports of these different products after the war is explained in large part by the numerous clear cuttings executed in this country.

In grand total, and including certain products not indicated above, the value of forest products imported in 1920 amounted to 446,849,851 francs, as compared to 162,985,799 francs in 1913.

EXPORTS

The value of all forest products exported in 1920 was 111,765,798 francs, against 40,261,630 francs in 1913.

Exports have diminished in quantity of material and increased in value in proportions comparable to the imports. In other words, the quantity has diminished more than half, while the value has almost tripled.

CUSTOMS DUTIES

Import and export duties are applied per cubic metre, except for certain manufactured woods on which the tax is ad valorem.

In 1920 the state received an income of 7,116,833 francs from this source.

HUNTING

The products of "the chase" are represented as follows for 1922:

Income from Hunting

	Francs
(a) Received by the state (22,000 licenses at 200 francs)	4,400,000
Received by the provinces (22,000 licenses at 20 francs)	440,000

(b) Leasing hunting sites in state forests	190,000
Leasing hunting sites in town and public establishment forests	1,200,000
Leasing hunting sites in private forests	2,000,000
Leasing hunting sites on the plains	6,000,000
(c) Value of game (3,500,000 kilos at 5 francs)	16,500,000
(d) Commerce in guns, ammunition and equipment for Belgian hunters	7,000,000
Total	37,730,000

Numerous subsidiary values, such as the returns to raisers of dogs and game, to means of transportation, to hotels, and to merchants are not included in the above total.

FISHING

The products of river and stream fishing during 1922 can be evaluated as follows:

Income from Fishing

	Francs
(a) Leasing of sections of streams for fishing	50,000
Leasing fortification ditches	15,000
(b) Fishing permits and licenses	419,000
(c) Value of the fish (1,500,000 kilos at 5 francs)	7,500,000
Total	7,984,000

Beside this, fish produce business for fishermen, transportation agencies, hotels, merchants, etc.

We have seen that Belgium's annual production of wood amounts to a value of 50,000,000 francs on the stump.

This wood when worked acquires a value, according to the price of imports, of six or seven times its stumpage value, or 300 to 350,000,000 francs.

Having imports to a value of 447,000,000 francs and exports of 111,000,000, we have consumed (325,000,000+447,000,000)—111,000,000=661,000,000 francs of forest products. Of this total 336,000,000 francs is chargeable as foreign.

Our own normal production has eliminated a purchase of 325,000,000 francs from foreigners and has permitted us to make a sale of 111,000,000 francs to the foreign nations.

It has thus produced a very good influence on our exchange and on our balance.

If we add to these advantages the benefits from customs duties, hunting and fishing, or 52,830,833 francs, we will have shown that the forests hold a very respectable place in the economics of our country.

Beside the eminent services rendered in this field by the forest administration, there remains to be noted the various associations which have contributed directly or indirectly in this work, as follows:—the Central Forest Society of Belgium; the League of Friends of the Forest of Soignes; the Superior Councils of Forests, Hunting, etc.; the Central Society for the protection of fish in streams; the magazine Hunting and Fishing; the Touring Club of Belgium; the National Commission for the improvement of country life; the Royal Commission of Monuments and Sites; the Belgian Society for clearing land, etc.

May their efforts, strengthened by public opinion, continue to enrich our national forest domain for the greater physical and moral well-being of our dear country.

THE RECLAMATION OF STRIPPED COAL LANDS

By F. W. Dean

Ohio Department of Forestry

There are approximately 16,000 acres of coal lands in Ohio subject to stripping. These lands are located in Jefferson, Harrison, Tuscarawas, Perry, and Muskingum Counties.

The contents of this paper comprise the results that have been obtained from the forest plantings on the holdings of the Wayne Coal Company in Harrison and Jefferson Counties.

Stripping coal lands is a mechanical process by which the upper layers of soil and rock formations are removed down to the vein of the coal. The depth of the cuts or large trenches, vary greatly in degree of thickness, however in some cases they average 30 to 50 feet in depth. The extensiveness of these strippings is so large that it is impossible to remove or level off the surplus earth without the addition of extensive costs consequently the earth must be thrown up or piled by large steam shovels in massive heaps, producing a series of ridges of great irregularities, and extreme steep slopes. Such areas are known or termed as "Spoil banks," and constitute the waste lands of a stripping operation. In some places these banks or piles of earth will range in height from 30 to 50 feet and with slopes 20 to 30 degrees in steepness. The height and steepness of the spoil banks make agricultural activities an impossibility. However in Jefferson and Harrison Counties due to an abundance of lime content, the subsoil that is thrown out is in a high state of fertility. During the removal of the earth from the upper strata of the coal, an abundance of limestone rock is thrown out which is easily broken up by the mechanical operation of the steam shovels and later on by exposure to weathering agencies of the atmosphere. This layer of limestone lies about 10 feet above the layer of coal and varies from 8 to 10 feet in thickness. Upon disintegration the surrounding soils are greatly increased in lime content by reason of coming in contact with extensive masses of limestone rocks.

Upon invitation by the Company's representative an examination of the Company's holdings was made by the State Department of Forestry during the fall of 1919. The object of the examination was to determine the direct value of these lands for forestry purposes, and

to suggest species that might be adapted to the specific conditions that have been described.

It should be mentioned at this time that already the Company had started to reclaim some of the stripped lands by sowing a quantity of sweet clover seed on the spoil banks. This was done during the season of 1918 on banks that had been thrown up in 1917. The following year a luxuriant growth was established in several places on the spoil banks. So far as establishing a complete vegetative cover over the stripped lands the problem seemed to be solved by sowing the clover along the top of the sharp ridges and each succeeding year sufficient seed would be furnished to distribute the legume along the steep slopes, and the lower levels below the ridges.

By reason of the physical features the spoil banks seemed to be better adapted for forestry than any other purposes. It was suggested that if a forest crop could be harvested on a rotation of 15 to 20 years it would in the long run be more profitable to the Company than any other use of the land notwithstanding the fact that perhaps certain areas could be reclaimed for grazing purposes. However it was readily observed just as soon as the steep banks were disturbed, on account of the loose physical condition of the soil, erosion would immediately start and consequently be followed by severe slides.

The proposition of grazing would certainly be out of question under these circumstances inasmuch as the disturbance of the soil and consequent erosion would be greatly enhanced by the continual tramping of sheep or cattle. Forestry therefore seemed to be a logical proposition, and if a species could be adapted to these areas that had a relatively short rotation the dual purpose of reclaiming the stripped lands and at the same time yielding a profitable income upon the lands would be accomplished. It therefore was suggested by the department of forestry to the Company that trial plantings of several species be made on the Company's holdings. Special emphasis was placed upon the planting of black locust in consideration of the fact it was a legume and would be highly adaptable particularly to the Company's lands in Harrison County.

Other species that were recommended for forest planting on the spoil banks were white, red and Scotch pins, white ash, tulip poplar, and black walnut. It is the purpose of this paper to deal chiefly with the planting of the black locust, and its posibilities for reclaiming the spoil banks or stripped lands, and the accomplishments toward this end the plantings have already made.

The first trial plantings were made during the spring of 1920, when a small block of black locust seedlings were planted on the oldest of the spoil banks that had been formed during the year of 1917. A period of 3 years had allowed the steep slopes to become stabilized to the extent that there was no appreciable settling excepting the process of erosion which in several places where the slopes were devoid of any vegetative cover erosion was rapidly going on. The remarkable growth of the black locust during the first year was so encouraging that it was decided to initiate a larger planting program the following spring. In the spring of 1921 approximately 10,500 black locust seedlings were planted on the spoil banks under the supervision of the department of forestry. These trees covered an area of 11.8 acres on the spoil banks.

The seedlings were 1 year old stock, 12 to 18 inches in height. All of the trees were spaced approximately 7x7 feet.

The planting was done by the cleft method. The soil was loose enough so that it could be easily worked by this method. The method of procedure was simply to drive the blade of a spade into the ground and work it backward and forward once or twice and then the seedling was inserted into the cleft or hole. It was then firmly set or tamped by the foot after inserting the spade just back of the tree, and pressing the soil solidly up against the roots. So far as the planting goes this was comparatively a simple process, and the trees were planted in rapid fire manner.

The cost of planting the trees amounted to $7.72 per acre, or about $.0087 (eighty-seven hundredths of a cent) per tree. This does not include the cost of the planting stock which was furnished by the State Forestry Department from its own nurseries.

At the same time the advisability of planting the locust by direct seeding was tried out. The seed spots were spaced 7x7 feet, the same distance as the seedlings. Approximately 12,000 seed spots were made on the spoil banks covering an area of 13.70 acres. The costs by this method of planting were greatly reduced, however not over 10 per cent of seed spots germinated. Such a poor showing in direct seeding was anticipated, considering the very unfavorable conditions under which the seed must be planted. It was not possible to cover the seed deeply for fear of postponing germination and again due to the constant washing by hard rains on the exposed portions of the spoil banks the seed was washed out or possibly carried to the bottom of the steep slopes.

The cost of planting the seed spots was $3.19 per acre, or about .35 of a cent per seed spot. This included the cost of the seed, which amounted to 10 pounds at a total cost of $8.50.

During the spring of 1922, approximately the same number of black locust were planted as in spring of 1921, or approximately 11,000 trees on the spoil banks. In addition to the black locust there were planted 5,000 black walnut, 1,000 tulip poplar, and 100 jack pine, making a total of 17,200 trees, covering approximately 17 acres of the spoil banks. The trees were planted in the same manner as the trees were the previous spring.

The cost per acre was, however, slightly lower, being $7.65 per acre, or about .85 of a cent per tree.

The rapid growth of the black locust upon these areas from the time of their planting is most remarkable. During November of the past year, (1922) a series of measurements were taken in those plantings that were made during the spring of 1920. Up until this time they had 3 seasons' growth.

The following average measurements are as follows: average height growth 16.5 feet. Average diameter growth taken 3 feet above the ground 2.2 inches. In measuring these trees 2 average rows were chosen in the planting. Some of the trees had a maximum diameter of 2.8 inches, 3 feet above the ground, and maximum height of 19.5 feet.

A series of growth measurements were also taken of the trees that were planted in the spring of 1921. Up to the time they were measured, they had 2 seasons' growth. The following average measurements for these trees are as follows: average diameter growth taken 3 feet above the ground 1.24, average height growth 9.5 feet. The maximum height in the 2 average rows was 13 feet while the maximum diameter 3 feet above the ground was 2.0 inches.

Favorable growth conditions were made possible first by the physical condition of the soil. By reason of the fact that in the stripping process the subsoil is completely turned over and thoroughly mixed with the surface soil makes conditions ideal for the deep penetration of the vigorous root system of the black locust. Again as has been stated before, the high lime content of the soils in the Harrison County section is particularly suitable for legumes. Before the black locust was considered in the reclamation scheme of the spoil banks, the luxuriant growth of the sweet clover had already demonstrated this fact.

One of the most discouraging features in several sections of Ohio in the growing of locust has been the severe devastation or complete destruction of locust plantations by the locust borer. Before planting the spoil banks an investigation was made of the native locust in the surrounding area and it was found that the oldest trees showed comparatively no infestation by these insects. These observations were made in both Jefferson and Harrison Counties in the vicinity of the Company's operations. During the short space of time that the trees have grown there is not the slightest indication that the borer is present to any degree among the plantings. It therefore appears that the locust borer will not be a serious factor as it has been in destroying the locust in other sections of the state. However, there has not been sufficient time to determine their complete absence from the plantings.

In a few places plantings were made among the luxuriant growth of sweet clover on the banks. In consideration of the strict competition offered by the clover the locust made an appreciable showing. In places they were considerably stunted by the limited amount of soil moisture available both for the locust and the sweet clover.

I might say at this time the other species that were tried together with the black locust in the reclamation project, namely; white, red, Scotch, and jack pines, tulip poplar, and black walnut have shown little or no growth. With the possible exception of the black walnut and tulip poplar the other species have failed. However, the time has not been long enough to warrant a statement to the effect that they have been a complete failure.

The growth of the black locust has so out-distanced the other species during the short interval of three seasons' growth, that it is difficult to compare the growth of the other species with its showing. We do know, however, that the black locust has fully demonstrated its ability to grow on these areas and should be the major species in all future plantings.

We have in this reclamation project a concrete example how forestry can be practiced to advantage on waste lands. It is a splendid example of how private landowners, whether large or small, can by complete cooperation with the public interests, which in this particular case was the State Forestry Department, get together and decide that it is to their best interest that their land should be reclaimed rather than to remain idle as a liability.

There is no reason to believe but what the majority of these trees can be cut for posts within the next 15 years as a mimimun rotation and in thinnings, posts should be produced within 6 to 8 years.

A summary of the reclamation work accomplished by the Wayne Coal Company on stripped coal lands in cooperation with the Department of Forestry is as follows:

(1) A total of 45 acres has been devoted to forestry work in Jefferson and Harrison Counties. This does not include plantings in Tuscarawas and Perry Counties.

(2) The cost of planting the trees was approximately $7.45 per acre or .85 of a cent per tree. The cost of direct seeding was $3.19 per acre, or about .35 of a cent per seed spot. The direct seeding proved almost a failure. Only about 10 per cent of the seed spots germinated.

(3) The adaptability of the black locust seedlings to the spoil banks and their remarkable growth. Seedlings that were planted in spring of 1920 after 3 seasons' growth average 16.5 feet in height and 2.2 inches in diameter 3 feet above the ground. Seedlings that were planted in spring of 1921 after 2 seasons' growth average 9.5 feet in height, and 1.24 inches in diameter 3 feet from the ground. The maximum diameters of the trees in some instances planted during the spring of 1920 were nearly 3 inches and a height growth of approximately 20 feet while those planted in 1921 often attained a maximum height of 15 feet and a maximum diameter of 2 inches 3 feet above the ground.

(4) Other species that were planted including several pines, black walnut, and tulip poplar have shown little or no growth. Aside from black locust, the hardwoods, black walnut, and tulip poplar seem to be better adapted to the spoil banks than the conifers.

In conclusion it might be said that the Company has manifested a deep interest in the forestry and reclamation work when it becomes apparent that the black locust was well adapted to their particular conditions. They are willing to embark upon a planting program of 100,000 trees each spring if it is possible for the Ohio department of forestry to furnish the number requested.

REVIEWS

"Tropical Woods." Tropical Series No. 1. March, 1925. 5½x8¼, pp. 16. Yale School of Forestry, New Haven, Conn.

This is the first of a new series of publications to be devoted solely to tropical woods. It is cordially welcome.

The Yale School of Forestry has taken front rank in the short space of eight years in tropical wood researches. The tropical forests are increasingly in the eyes of the prospector for new sources of plain and fancy hardwoods to eke out our own dwindling native supplies. New information, general and scientific, constantly becomes available and a large share of it emanates from the Yale school.

In the introduction, the editor, Professor S. J. Record, Professor of Forest Products at Yale University, and a leading investigator in tropical woods, has this to say about the new Tropical Series: "In the course of the investigations, new facts come to light which, it is felt, should be made promptly available to other investigators; also many problems arise upon which assistance is needed in solution. It is for this reason that this new series of publications, *Tropical Woods,* has been instituted. It is planned to issue succeeding numbers at such intervals as available funds and material will permit."

The initial number contains eight miscellaneous notes and a check list of the woods of British Honduras. The notes cover such topics as the distribution of the species of Swietenia; crossties in Salvador; cocobolo; lapachol; secretory canals in hardwoods; some trade names of woods; *lecythidaceae; escallonia.* All of them appear to embrace data collected since the appearance of the author's large work *"Timbers of Tropical America."* The first number of the Yale Tropical Series will no doubt prove to be the forerunner of an important publication recording the progress in knowledge on tropical woods. No doubt most of the matter appearing in the Tropical Series will come from the laboratory and pen of Professor Record; it is to be hoped, however, that the editor will accept the contributions of others or at least record work done outside of Yale in a form of current literature department. It is unfortunate that such publications must depend upon the meager allotments and overworked finances of universities.

E. F.

"*Dry-Rot in Buildings and Stored Construction Materials and How to Combat It.*" By C. J. Humphrey and L. E. Miles. Extension Service Circular 78, The Alabama Polytechnic Institute, Auburn, Ala., Feb., 1925.

This is perhaps the best popular bulletin on the subject of dry rot. It is written in very simple English and is very well illustrated. The illustrations are very well selected and drive home the story of the decay of wood. One plate showing fruiting bodies and mycelium bodies is in colors. The text discussion and illustrations are confined to the virulent *Poria incrassata*. Paragraphs are devoted to, Why timber decays; What dry rot is; How to distinguish *Poria incrassata;* Where the responsibility lies; Points of danger; How to eradicate dry rot from buildings; How to free lumber yards of dry rot; Method and cost of preservative treatments.

Foresters and lumbermen not well acquainted with the work of fungi in destroying wood would do well to study this bulletin. It is real conservation when one can save forests by preventing the destruction of their products.

E. F.

"*The Diagnosis of Decay in Wood.*" By E. E. Hubert. Journal of Agricultural Research, Vol. XXIX, No. 11, pp. 523-567. Washington, D. C., December 1, 1924.

This article is concerned with the diagnosis of fungi causing stains and decays in wood, a subject which has heretofore apparently not received much space in the literature of forest pathologists. In the study presented in this paper, the author shows how "gross, histological and cultural characters may be applied to the diagnosis of decay in wood." Heretofore the principal means of identifying decay-producing fungi was through the sporophore that may be attached to the decayed wood. These are rarely present, however, especially on manufactured products, hence the desirability of basing identification on cultural characters.

Following a few somewhat general paragraphs on the diagnosis of decay, stages of decay, decay processes, and classification of wood rots, the author launches on the characters of decay-producing fungi which may be used in their identification. First are considered the gross characters—color, of which is said "the discolorations usually associated with the stages of a particular decay are the most valuable diagnostic characters visible to the naked eye"; zone lines, which are typical of the work of some fungi and which the author finds often appear after an infected freshly cut surface is exposed and dried out; texture; brash-

ness; odor; and chromo-chemical tests. Next the microscopical characters of decay are presented.

"The order of dissolution of the cell wall may often suggest the type of decay," and "corrosion, thinning, and entire decomposition of the cross walls are prominent characters in the medullary rays. Whether pit openings or bore holes are used as channels for *hyphae* may aid in distinguishing wood destroyers from staining or molding fungi." The paragraphs on extent of *hyphae* in and beyond discolored areas are suggestive of a commercial application, especially in those cases where timbers are to be selected and graded for strength or resistance to decay. It is important to know that the *hyphae* of any decayed portions that are sawed off may extend into the apparently sound wood, ready to grow and extend when conditions become again favorable. "Microscopical evidence.....indicates that in certain rots the *hyphae* advance as far as the edge of discoloration; and that in other rots, principally those of the brown rot group, the *hyphae* may be found a considerable distance beyond the faint discolored areas in the incipient rot region."

The cultural characters are in the third group considered important in diagnosis. In many cases these furnish "the evidence necessary to complete the identification of the fungus decomposing the wood." The artificial production of typical decays is described. The organism to be studied is isolated and then some of its *mycelium* is planted on sound, sterilized wood. The cultural data includes "observations on the source of the *inoculum;* the macroscopic and microscopic characters of the *mycelium*, with emphasis on secondary spore formation; the size, color and character of the hymenial layers produced in the near-typical and typical *pilei;* and the conditions of heat and light to which the cultures were exposed. To these data may be added proof of the important question whether the isolated fungus when placed in contact with sterilized, sound wood under favorable conditions produces a rot identical with that from which it was isolated."

This paper not only establishes the author as a scientist of considerable promise but it also introduces him as an accomplished artist. In addition to a large number of excellent and original photographs depicting typical rots, there are six pages of line drawings containing many more subjects illustrating the result and spread of decay in trees, logs, and cells. Of particular interest are those illustrating the mechanics of cell wall decomposition. No doubt many of these cuts will be copied by future writers and will thus become standard illustrations.

E. F.

"Effect of Kiln Drying, Steaming and Air Seasoning on Certain Fungi in Wood." By E. E. Hubert, pp. 20, plates 5. U. S. Dept. of Agriculture, Department Bulletin 1262, Washington, D. C., August, 1924.

This bulletin reports the results of a study "to determine whether the fungi in lumber are killed under ordinary commercial kiln conditions and steaming processes and to gain some idea of the minimum time and temperature limits necessary to kill these organisms."

The need is shown for some practical method or methods of sterilizing wood against the fungi inhabiting it, and the wide application of such methods to the wood producing and consuming industries is indicated.

The tests carried out show that a long list of wood-inhabiting fungi in a variety of woods can effectively be arrested in their development through sterilization by heat.

Of the various fungi tested the blue-stain fungi appear to be the most resistant to heat. No great differences in resistance were noted among the various rot-producing fungi tested.

Commercial kiln conditions and steaming processes coming within the effective limits of temperature and time as determined by the tests are effective in sterilizing infected wood up to and including pieces four by four inches square. Pieces six by six and eight by eight inches square were sterilized when subjected to 130 degrees F. for a period of nine hours. Sterilization was also effected by steam-pressure treatments.

Methods of piling and storage are important factors in protecting wood against deterioration due to fungi.

Certain fungi continue to develop in wood as long as favorable conditions are present, and they will revive and continue development after long periods of drying.

From the data obtained it is assumed that wood that is properly kiln dried will be sterilized and that with proper storage it will remain bright and sound.

E. F.

"Form Factors in the Measurement of Stands." By Erling Eide, Report of the Norwegian Forest Experiment Station, Vol. 5, Oslo, 1925, pp. 38-50.

Dr. Eide, Director of the Norwegian Forest Experiment Station, gives a résumé (in German) of the studies made by his station on the applicability of Jonson's form point method in various Norwegian stands.

Thirty stands of Scotch pine varying in age from 20 to 130 years and in site quality from two to five were studied. The results bore out Jonson's theory except that trees of the smaller diameters were underestimated and those of the larger diameters were over-estimated. The maximum variations were plus 6.36 per cent and minus 4.40 per cent.

In the case of spruce a similar study of 36 stands showed a departure of plus 5.1 per cent and minus 4.5 per cent. The irregular nature of the Norwegian spruce forest leads the author to question the applicability of Jonson's method in timber estimating.

The author argues for a study of the form of *stands* not of individual trees. Thus alone can justice be done to the variations in diameter within the same height class and the variations in height for trees of the same diameter. The Norwegian Experiment Station plans further studies along this line.

A. B. R.

"Mustilan Kotikunnas (Arboretum Mustila)." By Dr. A. F. Tigerstedt. I Havupuut, Werner Söderström Osakeyhtiön Kirjapainossa, Porvoossa, Finland, 1922. Pp. 230, full page plates, 51.

This book is an account of an arboretum, established in 1901, on the estate of the author, Mustila, at Koria, Elina, Mustilagard, Finland. Its publication was in part due to the recommendation of Prof. A. K. Cajander, President of the Forestry Department of Finland. The text is in Finnish but there is an English preface of 14 pages. The titles of the 51 full page plates are also accompanied by translations in English. The present volume treats entirely of conifers, the inference being that it is to be followed in time by another on deciduous trees, the experiments with which as yet are "far from conclusive." Mustila Estate comprises some 6,000 hectares, more than half of which is in timber, with 200 hectares devoted especially to experimental work, done at Dr. Tigerstedt's own expense.

Dr. Tigerstedt began experimenting with exotic trees in the hope of adding to the limited tree flora of Finland species that would be of economic value. His intention has been "to form real groves or small

forests of every reliable species of which seed could be discovered, planted according to practical forestry rules," although individual specimens of rare trees, including some ornamentals, have also been planted.

Reference is made to the help that Dr. Tigerstedt has found in such American books as Sargent's *Silva & Plantae Wilsonianae,* Sudworth's Trees of the Pacific Slope, Whitford & Craig's Forests of British Columbia, the Journal of Forestry, and bulletins of the U. S. Geological Survey.

Mustila is situated 60 degrees 44 minutes N. and 26 degrees 29 minutes E., on the Fenno-Scandinavian plateau. The soil is clay, over glacial drift. As to climate, the mean temperatures for February and July are, respectively, 21 degrees and 63 degrees F., with summer and winter maxima of 95 degrees and 31 degrees F. Precipitation, 600 to 700 mm., mostly from July to November, snow from January to March. Four months are practically free from frost, May 15 to September 15.

The trees "which have been subject to experiments" are given as follows: *Taxus,* 2 species, *Tsuga* 5, *Pseudotsuga* 2, *Abies* 29, *Picea* 22, *Larix* 9, *Pinus* 24, *Thuyopsis* 1, *Thuya* 2, *Chamaecyparis* 3, *Juniperus* 1, a total of 100 species. In the English preface a brief paragraph for each species gives comments as to whether the tree grew fast or slow, and as to its hardiness and special requirements. The titles to the full page illustrations (from excellent photographs) give the age, height in meters, length of top shoot in centimeters, and brief notes as to soil, situation and undergrowth. Attention is called to those species that have begun to produce cones, and to other special features.

Modestly noting that 20 years is all too short a period to warrant the drawing of conclusions, Dr. Tigerstedt makes certain observations that are of interest: (1) "The experiments at Mustila seem to show that at least in that part of Europe, the western American trees coming from regions at a suitable distance from the Pacific, are the most promising among exotics. Only the larches make an exception." (2) "The geographic peculiarities of northwestern America make, however, the exact origin of the seed a matter of utmost importance, good results with Douglas fir being obtained only when seed from Upper Fraser Valley was secured (Quesnel). The same can be said of lodgepole pine. All trees from the shore line of southeast Alaska are too tender, but a little alternation in origin of seed seems to suffice to give excellent trees in Finland, combining hardiness with rapid growth."

In a copy of his book presented to Dean A. R. Mann of Cornell University, and now in the hands of this reviewer, Dr. Tigerstedt has

checked certain species that from his experience he feels may be of special value in North America. Some of these are American species, some from other regions. Of the latter the more important appear to be *Picea excelsa* var. *obovata* Ledeb., Siberian spruce, "as good in all respects as the European"; *Picea omorica* Pancic, Servian spruce, "in all respects of highest value"; *Larix kurilensis* Mayr., Kurile larch, "a very fast grower, must be studied more"; *Larix Principis Rupprechtii* Mayr., Korean larch, "remarkable growth"; *Pinus Peuce* Gris., Macedonian pine, "immune from blister disease, hardy."

In addition to the work in his arboretum, Dr. Tigerstedt has given considerable attention to the making of thinnings and to soil drainage. As another exponent of the practical value of the "race testing" experiments, a subject which vitally interests so many of the foresters of northern Europe, it would seem that Dr. Tigerstedt's work should be better known to the members of the forestry profession.

RALPH S. HOSMER.

CORRECTION

"Hemlock: Its Place in the Silviculture of the Southern New England Forest." By Perry H. Merrill and Ralph C. Hawley. Yale University: School of Forestry Bulletin No. 12.

In the review of this bulletin published in the Journal of Forestry for April, 1925, Behre was twice cited as authority for the compilation of the yield tables as outlined in detail in the appendix. This was an error which this note is intended to correct, since Behre's part in the project was confined to the derivation of tables of taper as the basis for the volume tables.

T. S. W., Jr.

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Compiled by Helen E. Stockbridge, Librarian, U. S. Forest Service

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NOTES

Frederick Erskine Olmsted

The Committee appointed to pass resolutions on the death of F. E. Olmsted, submitted the following statement:

"Frederick Erskine Olmsted was one of the founders of American forestry. Educated at Yale as an engineer, he was one of the first to sense the crucial importance of forestry in the life of the Nation, and not long after graduation, while forestry was still a calling for pioneers, he adopted it as his profession. After extensive study in European forests, he returned to the United States, and from that time on took a leading part in the establishment and development of wiser ideals and sounder practice in the treatment of American forests.

No forester had a more important share than he in the selection and establishment and in the introduction of organized forest management upon what are now the National Forests. No one brought to the consideration of their problems, and later of general forest problems in America, a keener intelligence and more loyal devotion, or a saner understanding of the conditions of successful forestry in the United States.

Under a quiet bearing, he possessed a very rare degree of selfless and daring courage which, with his penetrating alertness and keen judgment, never failed to make him a factor of the first importance in any enterprise he had undertaken or in any council in which he sat.

As President of the Society of American Foresters he rendered two great services to his fellow foresters, and to the Nation. One was through his effort to establish and crystallize a high standard of professional ethics; the other through his vigorous and sustained attempt to awaken both professional foresters and the people of the United States to the urgent necessity for putting an end to forest devastation on the unprotected timber lands of America.

Frederick Erskine Olmsted was a most loyal and faithful friend; a fearless, open and uncompromising opponent; a forester of the first distinction; and a public servant whose contribution to the cause of forestry and conservation will give his name an abiding place in the history of the greatest movement of our time."

E. A. Sherman,
Ralph Bryant,
Gifford Pinchot, *Chairman.*

MEXICO FORESTAL—A NEW CHAMPION FOR FORESTRY

Although rather tardy, the Journal is glad to take this occasion to extend a welcome to "Mexico Forestal," the monthly journal published since January, 1923, by the Sociedad Forestal Mexicana. This journal is somewhat similar in style and appearance to the Spanish "Espana Forestal," and corresponds in a general way in Mexico to American Forests and Forest Life in the United States. Its object is the education of public opinion to an understanding of the need for conservation of forests and collateral natural resources, in order to bring about suitable legislation, as well as an intelligent and sympathetic attitude on the part of private forest owners and the public in general.

The problem of forest conservation is exceedingly important in Mexico, because of the extent to which forest devastation has gone during a 1,000 years or more in the more thickly settled portions of the country. Only about 200,000 square kilometers—less than 50,000,000 acres—of real timber forest remains, or about 10 per cent of the total area of the country.

The Sociedad Forestal Mexicana was organized in 1921, to take the place of Junta Central de Bosques y Arboledas, which was active from 1906 to 1910. The president of the Society is that pioneer of the Mexican forestry movement, Senor Miguel A. de Quevedo. Its objectives include the following:

1. To promote forestry education in Mexico, both technical and popular.
2. To protect members of the forestry profession.
3. To promote the conservation of forest resources.
4. To publish "Mexico Forestal."
5. To protect and encourage the planting of trees along streets and highways and in parks.
6. To encourage the reforestation of denuded lands.
7. To promote a regulated exploitation of forest resources.
8. To carry on forestry propaganda through the medium of affiliated local organizations throughout Mexico.

W. N. S.

FLYING ANTS IN BUILDINGS

Each spring or fall, numerous small flying ants (our native termites or white ants) emerge from the woodwork of buildings that have not been properly constructed. They have entered the woodwork of the buildings because, somewhere, there is untreated wood in contact with the ground.

Recently, the Bureau of Entomology has been advocating slight modifications of the building regulations of various cities in efforts to prevent attack by these insects. No untreated wood should be laid on or in the earth, and untreated beams should have at least an inch of concrete between them and the earth. Where it is desired to put wood in direct contact with the earth, it should first be impregnated with coal tar creosote. If this is not practical there should be foundations of concrete or stone. No lime mortar should be used in brick work in foundations of buildings, since termites are able to penetrate lime mortar after a few years' service. Such brick work, either on or extending below the surface of the ground, should be faced and capped with concrete at least one inch thick.

Termites are not like ants, which can be killed by insecticides or fumigation. They must be prevented from getting into the building from the ground by means of their hidden burrows through untreated woodwork.

The Department of Agriculture has received as many as 200 requests this year for help in getting rid of these flying ants. It is a great hardship for a householder on a moderate salary to have to spend several hundred dollars one or two years after purchasing a building because of damage by termites. The fault is with the architect or contractor and the householder should not have to pay. By insisting on complete insulation of all untreated woodwork from the ground, insurance against attack by termites can be secured.

T. E. Snyder, *Entomologist.*

MINNESOTA'S ONLY HEMLOCK GONE

The Cloquet forest fire which swept northern Minnesota in 1918, burned severely the area which included the only known stand of hemlock in the state.

Several years before the fire, Professor Cheyney reported hemlock in Section 20, Town 51 N., Range 19 W. of the 4th Principal Meridian. This is just north of the St. Louis River at the railroad siding of Paupores, Minnesota.

Since the fire there have been no authentic reports as to whether or not any of the hemlock remains alive. So on June 7, 1925, E. E. Probstfield of the Cloquet Forest Experiment Station and A. E. Wackerman of the Lake States Forest Experiment Station accompanied by S. R. Gevorkiantz and P. M. Barr, foresters, went to the location reported by Professor Cheyney and others to verify the existence of the

original stand and to learn of its condition. The area is not readily accessible, which accounts for the lack of information concerning this western extension of *Tsuga canadensis*. This is about the northern limit of the species as well as its most western. No other hemlock is known to occur for at least 100 miles to the east, in Wisconsin.

The original stand of hardwoods and hemlock was located, but the fire had killed everything and no reproduction of hemlock could be found. Numerous dead hemlock were seen up to 24 inches in diameter at breast height among smaller dead trees of all sizes, which seems to indicate that the hemlock in the stand was successfully maintaining itself.

The fire was so severe, however, that the ground was burned bare and no forest cover was left. These conditions are extremely unfavorable for the reproduction of hemlock so it is not surprising that there is no second growth of this species.

From the dead trees in the stand it was found that the species in mixture were hemlock, hard maple, soft maple, yellow birch, paper birch and an occasional white pine, spruce and balsam. Practically all of these species are reproducing sufficiently to re-establish themselves, with the exception of the hemlock as mentioned previously. The soil is typical for this type—a rather heavy, gray clay with moist pockets.

On the burned areas there is but slight chance that any of the hemlock escaped the fire or will reproduce itself. If any remains it is in a sheltered group somewhere where the fire was not so severe as in the open. No such groups were seen, however.

A few miles further north, across an extensive swamp, there appeared to be a green hardwood forest and this may contain a few hemlock in mixture although none have been reported except on the area visited.

Specimens of hemlock wood, bark and fruit were brought back to establish the fact that hemlock did once exist in Minnesota though a careful investigation failed to reveal a single living hemlock left.

A. E. W.

INTERNATIONAL MEETINGS

April 29 to May 5, 1926, has been set as the date for the World's Forestry Congress at Rome next year. This is immediately before the General Assembly of the International Institute of Agriculture. An agent of the United States Lines has expressed the hope that persons attending either the Congress or the Assembly will travel by these lines, and has suggested the possibility of making special arrangements

for those doing so. An ample supply of the tentative regulations and program for the Congress, and of application blanks for membership in it, is now on hand. Copies will gladly be supplied to any one interested on request to the undersigned.

The centenary of the National School of Waters and Forests will be celebrated by a two-day meeting at Nancy, France, on July 19 and 20, 1925. The first day will be devoted to the dedication of a memorial tablet, a visit to the school and reception, and a banquet with the Minister of Agriculture presiding. On the second day there will be automobile excursions in the forests of Haye and Amance, with theatre and moving pictures in the evening. From July 15 to 18, just prior to the celebration at Nancy, there will be organized excursions in the Vosges Mountains. American foresters are cordially invited to participate in the entire program.

Immediately following this meeting an International Forestry Congress will be held from July 22 to 30, 1925, at Grenoble under the auspices of the Touring Club of France. American foresters will also be welcome at this congress.

Plans are being made for a revival of the International Union of Forest Experiment Stations by a meeting in Sweden in 1926. The first meeting of the Union was held in 1893 and the last in 1910, the meeting scheduled for 1914 having been abandoned on account of the war. It is understood that one of the topics to come before the meeting next year will be the continuance of the international bibliography of forestry literature which was started by the Union and to which the Society of American Foresters at one time contributed $125.

S. T. Dana,

Chairman, Committee on International Relations in Forestry.

CONFERENCE ON STATE PARKS

The Fifth National Conference on State Parks was held at Skyland, Virginia, May 25th to 28th. The meeting was quite well attended by delegates and representatives from different states and organizations. The purpose of the conference is to promote the establishment of systems of state parks.

The program consisted of talks, and field trips in the Blue Ridge Mountains over the site of the proposed Shenandoah National Park. A number of interesting papers were presented, among which were "A History of State Forests," by Major Stuart, of the Pennsylvania Department of Forests and Waters. This paper will be of interest to many foresters. "Good Roads in Parks and Forests," by L. E. Baykin,

of the Bureau of Public Roads. "Sanitation and Sewerage Disposal in State Parks and Forests," by Dr. L. L. Williams, Jr., of the U. S. Public Health Service. James L. Greenleaf, President of the American Society of Landscape Architects, made an especially good presentation on "Study and Selection of Sites for State Parks." Emphasis was placed on the need for careful selection of sites of outstanding features, which may be worthily dignified by the name of state parks. That the purpose and use of tourist camps and state parks should not be confused. Highways should be constructed to make state parks accessible from the outside, but should largely cease at the park entrance. There should be no intricate system of concrete boulevards, dissecting park areas. This paper has much to commend it to the foresters of this country, especially those interested in the administration of public forests.

Among other interesting contributions was Major Barnington Moore's discussion of "The Value of Preserving Watersheds in State Parks and Forests."

One feature of the program was the reports made concerning the progress in the acquisition and development of state parks and forests from the delegates representing the different states. A considerable number of the reporting delegates were foresters connected with the state departments.

Among the foresters reporting for their states were W. A. L. Bazeley of Massachusetts, K. E. Pfeiffer, of Maryland, Major J. G. Lee, Louisiana, J. S. Holmes, of North Carolina, Edmund Secrest, Ohio, Major R. Y. Stuart, of Pennsylvania and Robert M. Ross, of Vermont.

Representatives of state forestry departments or similar organizations were in attendance from Connecticut, Louisiana, Maryland, Massachusetts, North Carolina, Ohio, Pennsylvania and Vermont.

The primary use of the state park is recreation. Recreation is one of the several uses and purposes of the state forest. In many states, state forests are being developed with recreation as a concomitant feature, and they are supplying the purpose of the park, thus devoting public lands to the fullest possible use. A notable example is Pennsylvania. Massachusetts, Ohio and other states expect to develop their state forests along similar lines.

The forester must recognize the recreation side of the forest, and that the development of state forest systems will come faster and with less effort if the growing outdoor recreation sentiment is encouraged to get behind the public forest movement. If cognizance is taken of the recreation feature, it will prove no mean ally in forestry development.

EDMUND SECREST.

SOCIETY AFFAIRS

THE NEW POLICY FOR THE SOCIETY

The letter which Mr. Detwiler has sent to the Executive Council and which was published in the May-June number of the Journal has clarified an issue which has been before the Society for several years. My own attitude has probably been typical of many other members'. Not being entirely clear as to what exactly was involved in a broader policy for the Society and a more centralized machinery for carrying it out, I was disposed to let things go on as they were. That this could not safely be done, Detwiler's analysis of the situation has, to my mind, conclusively proved. His general analysis of the situation, the present status of forestry and the relation of the profession to the public can not, at this stage of the proceedings be amended or improved upon. It may be possible, however, to emphasize still more or to present new angles of what seem to me the main reasons why the Society must now boldly adopt a more vigorous and far-seeing policy and support a really competent paid secretary to carry it out. Just as in most cases the individual forester must largely create his own job, so the profession, as a whole, must create forestry as a public and a business policy. Not a few foresters individually have brought about substantial improvements in the handling of particular forest ownerships or localities, but the broader function which the Society might be fulfilling has not been realized. Without belittling the very notable achievements which forestry in the United States has made in its short life, I think it is fair to say that the profession, as a whole, has not the standing and influence which its professed function in our national life would seem to require. As a profession, and speaking in the broadest sense, we have to deal with science and scientific methods in the solution of our fundamental problems; we have to deal with public policy in the constant succession of federal or state legislation that is proposed or enacted; and finally, we must deal with employers, actual or prospective, the owners of the lands we expect to manage. In all of these three contacts, I believe we have fallen short of real effectiveness. Perhaps it is fairer to say that from now on we will fall short of real effectiveness unless we amend our policy and perfect our organization.

I should like, therefore, not only to endorse Detwiler's proposals most heartily, but also to make some practical contribution toward the solution of the financial difficulty. Personally, I do not believe that

the raising of the dues will result in more than a temporary reduction of revenue. Nevertheless, last winter as a small offset to a possible loss of income, I offered to start an endowment fund with a nest egg of $200. This offer was intended to be anonymous, but it seems now to have leaked out. In addition, I should like to make one more of the 25 senior members whose promise is required to validate Detwiler's check of $20. This makes two who undertake to pay $25 a year for five years in dues if a total of 25 such pledges can be secured.

The time is past for being over-cautious. There may be some risk in the new policy and the paid secretary, but unless the Society is willing to take this risk, it may fail in the next decade to achieve the progress to which its past achievements and its present opportunities entitle it.

R. T. Fisher,
Director of the Harvard Forest.

Why a Paid Secretary?

By the Man on the Job

The times have changed. The Society of American Foresters has grown from a small group with a relatively small resident membership to a large organization with national and international contacts. It has 14 sections, and others will doubtless be organized in the near future. Our subscription list at this date is 1,730 copies. The capacity for furthering the profession has increased with membership.

With the increasing membership, with a widely scattered Executive Council, with a large number of sections, standing committees, etc., there has been an enormous increase in the duties of the Secretary; and while he is given clerical assistance, he is under the necessity of "farming out" a number of duties. It has become increasingly difficult to secure a candidate for the position of Secretary, and this work is only undertaken by a member who is willing to assume the responsibility on account of loyalty to the Society as he does it with a distinct feeling that all of the things which should be done can not be accomplished. I believe that many members of the Society actually refrain from referring matters to the Secretary, knowing the burdensome nature of the work. This, of course, should not be the case, and every day's mail brings opportunities for new contacts, and opportunities for assistance to members are frequent.

If the Society is to advance, there must be provision for the adequate handling of the Secretary's work under favorable conditions of

time, office equipment and facilities. By this I mean that the work of the Secretary should not be conducted at the fag end of a hard day's work, after office hours and frequently disassociated from records of the Society. He should have opportunity to function in the capacity of a leader rather than finding himself overwhelmed with correspondence in regard to the Journal and other routine matters. The paid Secretary should take over many burdensome details from the President and thus permit him to give more time to the broader aspects of the profession.

Surveying the job as a whole, the paid Secretary will have ample opportunity for the fruitful use of all his time, and the Society will benefit in direct proportion to the ability of the man whom they are able to employ. CLINTON G. SMITH, *Secretary.*

SOCIETY COMMITTEES AND REPRESENTATIVES

Various Society committees and representatives as appointed to June 10, exclusive of the Editorial Board of the Journal of Forestry, are as follows:

Committee on Standardization of Forest Fire Control Measures
R. Y. Stuart, Chairman
H. R. Flint
R. C. Hawley
S. B. Show
E. O. Siecke
C. P. Wilber

Committee on Forest Education
Hugo Winkenwerder, Chairman
N. C. Brown
Committee not yet full organized

Committee on Forest Taxation
L. S. Murphy, Chairman
J. H. Foster
C. R. Pettis

Committee on History of Forestry in America
R. S. Hosmer, Chairman
P. W. Ayres
J. P. Kinney
L. S. Murphy
P. G. Redington
W. N. Sparhawk
P. P. Wells

Committee on Utilization of Forest Products
C. P. Winslow, Chairman
Other members to be appointed

Committee on Classification
C. F. Korstian, Chairman
J. M. Briscoe
A. B. Recknagel

Committee on International Relations in Forestry
S. T. Dana, Chairman
R. C. Bryant
R. S. Hosmer
R. S. Kellogg
W. N. Sparhawk
Raphael Zon

Committee on Charles Lathrop Pack Prize
Barrington Moore, Chairman
J. A. Ferguson
G. A. Peirson

Committee on Meetings
R. Y. Stuart, Chairman
Aldo Leopold
T. C. Spaulding

Committee on Standardization of Growth and Yield
H. H. Chapman, T. S. Hansen, D. T. Mason — Society
E. N. Munns, Chairman, C. E. Behre, Donald Bruce — Forest Service
J. F. Illick, M. B. Pratt, E. O. Siecke — State Forestry Department

Committee on Sections
A. A. Jaenicke, Chairman
H. O. Cook
Duncan Dunning
C. F. Korstian
Quincy Randles
R. H. Weidman
J. P. Wentling

Committee on the Revision of the Constitution
E. H. Frothingham, Chairman
Other members to be appointed

Member of Executive Council in Charge of Admissions, E. H. Frothingham. *Representative on Council of American Association for the Advancement of Science,* R. D. Forbes. *Representative on National Research Council Division of Biology and Agriculture,* R. C. Hall. *Division of States Relations,* F. W. Besley. *Representatives on Council of Union of American Biological Societies,* I. W. Bailey, Ward Shepard. *Representatives on Board of Control of Botanical Abstracts,* E. P. Meinecke, Raphael Zon. *Representatives on General Council of National Conference on Outdoor Recreation,* H. S. Graves, Franklin Moon. *Representative on Executive Committee of International Congress of Plant Science,* R. S. Hosmer. *Representative (Vice-President) on Washington Academy of Sciences,* G. B. Sudworth. *Representatives on Sectional Committees of American Engineering Standards Committee. Committee to Prepare Safety Code for Logging and Sawmill Ma-*

chinery, E. T. Clark. *Committee for Standardizing Railway Tie Specifications,* J. R. Coolidge, III. *Committee for Standardizing Methods of Testing Wood,* G. R. Green. *Committee for Standardizing Wood Poles,* Russell Watson. *Representative on Inter-Society Committee Working for National Arboretum in the District of Columbia,* F. W. Besley. *Representative for Meeting of Southern Pine Association,* R. D. Forbes. *Representative for Meeting of National Conference on State Parks,* Edmund Secrest.

CALIFORNIA SECTION

Proceedings—Meeting of April 30, 1925

The meeting of April 30th was held in Hilgard Hall, Berkeley, and was attended by 12 members and six guests (seniors of the school of forestry).

This being the last meeting for the 1924-25 season, the following officers were elected for 1925-1926:

T. D. Woodbury, Assistant District Forester, U. S. Forest Service, *Chairman.*

Emanuel Fritz, Assistant Professor of Forestry, University of California, *Secretary.*

The Treasurer reported receiving dues at $1.00 each from 27 San Francisco Bay members and at 50 cents each from 30 out-of-town members. Expenditures for postage, mimeographing, etc., totaled $33.28, leaving a balance of $12.32 as of April 30, from which must come current mimeographing and other expenses.

The principal topic of the evening was a discussion of what the policy should be toward white fir. This topic was suggested by a letter received from C. S. Smith, secretary of the California White & Sugar Pine Mfgrs. Assn., and reproduced below:

Gentlemen:

I am enclosing copy of a letter to the District Forester with reference to the problem of species of lesser present value in connection with future forests. The questions raised are exceedingly important. A great deal of fundamental information bearing on the subject is lacking and it will be necessary for all organizations interested in forest resources to take an active part in investigating the matter. It is hoped that your organization can be of material assistance in this connection.

It will be appreciated if you will notify me what phase of the problem interests you most particularly and what help you can furnish in connection with its solution.

Very truly yours,
C. Stowell Smith,
Secretary-Manager."

The letter referred to in the above letter follows:

District Forester,

Dear Sir:

In further reference to the March 27 meeting of the Special Lumbermen's Committee, I want to formally present to the Forest Service of this district the question of species of less present value in connection with management plans. This matter was discussed at the annual stockholders' meeting of the Association as a result of the following statement:

"A problem assuming increasingly greater importance is that connected with the utilization of so-called 'inferior species.' White fir and incense cedar are good examples. The correct solution of this problem affects the entire future of the lumber industry on both private and public lands.

"A considerable percentage of lumber manufacturers in this region are operating partly or wholly on public lands and this will continue indefinitely.

"The present policy of the Government is to discriminate against white fir and incense cedar as major species in the forests of the future. An attempt is made to secure sugar and California white pine reproduction and to suppress the others. The method followed is to force the leaving of pine seed trees and to force the cutting of white fir even at a great financial loss. Originally sugar pine was especially fostered, but the intermittent seed years, attacks by squirrels, susceptibility to disease, etc., soon demonstrated its fallacy. Now California white pine is the dominant tree desired.

"Based on present values, this policy is doubtless sound. Based on values from 100 to 200 years hence, it is certainly open to question.

"The history of the lumber markets shows conclusively that with closer utilization necessitated by the growing scarcity of timber, the value of so-called inferior species is advancing more rapidly than that of more valuable species. White fir and cedar are generally regarded as species especially subject to decay. This impression is founded upon the fact that the old trees, of which we have a large percentage, are badly

infected. Extensive investigation has conclusively proven, however, that white fir trees below 84 years of age, have no appreciable decay and that trees not badly suppressed or severely wounded, up to 125 or 130 years of age, are sound. Cedar trees are not subject to damaging rot until they pass 165 years and some are sound up to 210 years. This, then, fixes the maximum time to be allowed these trees to grow in the future forests and nobody is optimist enough to believe that any such rotation will be followed. Therefore, it is apparent that sound timber can be produced from these species.

"These trees are the best and most prolific seed bearers in our forests. That ensures a rapid natural establishment of the new forest after the old is removed, a process which is not so fast with California white pine and practically impossible with sugar pine. In addition, white fir is about the fastest growing tree in our forests, especially during the period that it would be allowed to develop. It will stand considerable shade, and therefore, will produce a heavy volume of wood per acre on a short rotation.

"From a lumber standpoint, and judging largely by experience with hemlock in the Lake States, white fir has an assured future. When it is considered, however, that white fir is about the most valuable pulp wood in the United States and in view of the rapid encroachment of pulp products on lumber products, it would seem desirable to use every reasonable means to reproduce it. The same line of reasoning applies to cedar to a large extent.

"Nature has apparently given us the opportunity for producing ample future supplies of lumber through natural means which man is doing his best to upset."

The Special Committee was instructed to thoroughly consider this problem and to make suitable recommendations to the Forest Service in connection with it. The question to be determined is whether the present Forest Service policy with reference to these species constitutes best forest management. It is realized that the answer is simply a question of fact and that possibly at the present time some data are lacking. It is proposed, however, that all interests involved give this subject most serious consideration and then each organization develop all possible information bearing on the following:

1. Comparison of cost and present returns of taking out these species.
2. The effect upon future stands if they are left.
3. The rate of growth of reproduction from these species.

4. The probable future value of product from these species, such as used for lumber, wood pulp, etc.

5. The effect of sales on small isolated areas where the conditions of private cutover lands will dominate the next stand.

The Committee will appreciate it if the Forest Service will include a thorough consideration of this problem as one of its immediate and neccessary projects.

Very truly yours,
C. Stowell Smith,
Secretary-Manager.

Mr. Smith was called on by Chairman Hammatt to elaborate on the subject. He gave in brief the attitude of a number of lumbermen toward the policy of the Forest Service in apparently discriminating against the fir, burning it up or otherwise handling it so that it will not be a prominent member of the stand to grow up after logging. He said white fir should not be looked on as an inferior species, that it is not good policy to take out all of the fir and that it is worth more left standing. This he said applies to both private and public lands.

Woodbury, following Smith, said the lumbermen were laboring under some misapprehensions in this matter. The Forest Service in California, he said, is not burning up white fir. The object of the present generation is to put the forest land into the best possible growing (producing) condition. He called attention to the fact that the Forest Service takes account of the low value of white fir in its appraisals, that it takes a loss where it insists that the white fir be cut, and that it feels justified in such an investment. One case was cited where a prospective purchaser complained of the percentage of white fir that must be cut, but who cheerfully agreed to cut it when he learned that if the white fir were to be left the appraisal might bring the stumpage value of sugar pine up to $9.00.

Dunning stated that data obtained by the Forest Service show that white fir does not yield as much as the pine on short rotations; this indicated that the belief that white fir yields more heavily than pine is incorrect. He called attention to the data available on growth; that much of it has been broadcasted to the lumber industry but that little of it is used.

Kotok stated that the Forest Service is not only leaving white fir seed trees where nothing better is available, but that it also seeks to protect white fir advance reproduction. The problem was referred to as an economic one and not a silvicultural one, a statement objected to by others who thought it was both.

The discrimination against white fir, where such exists, is based on its susceptibility to decay and not against it as a seed tree. The criticism of the Government's white fir policy is based on conditions that existed 12 years ago. The policy is quite different now.

In commenting on the lack of use being made of Forest Service growth data, it was suggested that the secretary of the Pine Association should take the responsibility in seeing that its members obtain it or learn about it. It was further suggested that the association, if it is interested in second growth crops, should take an active and leading interest in such particular cases as that in Plumas County, where immature second growth yellow pine is being cut into hewn cross ties with great waste of the trees and the production of a very inferior tie. Such destruction of the nucleus of a second crop should be discouraged.

Metcalf, commenting on the attitude toward cut-over lands, emphasized that the public's principal interest is in the question, "What is going on on the cut-over lands?" He quoted Show's statement that advance reproduction is the salvation of the forest in the pine region.

Someone quoted Prof. Roth of Michigan as saying that any kind of a tree is all right for the second crop. Mulford commenting on this said it does not go far enough, and that every acre of California timber land will have to produce increased value for the great population of the State of the future. It is not the function of the Government to make money. Question is, is pine enough better than fir to warrant any extra cost of getting more of it in the second crop. Emphasized the necessity of getting ample data on this to learn where we stand.

No conclusions were arrived at nor recommendations made by the meeting, but it was the feeling that there is much information on this topic already available that is not being used by lumbermen in determining their cutting policies if they are interested in the composition of second growth stands. It was also the general opinion that the policy toward white fir is an important question and should be studied carefully.

EMANUEL FRITZ, *Secretary.*

MINUTES OF THE WASHINGTON SECTION, APRIL 9, 1925, WASHINGTON, D. C.

The last meeting of the year was called to order by the Chairman, Mr. Chandler, at 8:15 P. M.

The Secretary read a summation of minutes of meetings held throughout the year in view of the fact that the reading of minutes had been dispensed with at monthly meetings.

The chairman of the Membership Committee, Mr. George Collingwood, presented the name of Mr. Clark Hunn, editor in the Branch of Research, Forest Service, for Associate Membership in the Washington section. Mr. Hunn was unanimously elected. The chairman of the Nominating Committee, Mr. J. G. Peters, reported the following nominations:

For Chairman—George H. Collingwood.

Secretary-Treasurer—John B. Cuno.

Member of Executive Committee—Franklin W. Reed.

As no other nominations were made, the Secretary was instructed to cast a ballot unanimously electing the above named men.

Mr. Chandler mentioned that while the Committee on Research of which Mr. Clapp was chairman, had done a very constructive piece of work, they were not ready to present their report. Mr. Chandler showed how the meetings for the year had been given over primarily to Research subjects.

PROGRAM—*"Forest Economic Research"*

Mr. H. M. Dixon, Extension Representative of the Bureau of Agricultural Economics, showed and explained some very interesting charts on prices for agricultural products. These charts yield information of direct value to the farmer in making price predictions and so regulating his crops.

Mr. C. W. Boyce, Pulp and Paper Specialist, showed and explained charts which revealed conditions in the pulp and paper industry in the United States and Canada.

JOHN B. CUNO,
Secretary-Treasurer.

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